Atlas of marine bony fish otoliths (*sagittae*) of Southeastern-Southern Brazil Part VII: Atheriniformes, Beloniformes, Beryciformes, Zeiformes, Syngnathiformes, Scorpaeniformes and Tetraodontiformes

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Abstract

In addition to the series of documents that we have been publishing on the "Atlas of Teleostei Otoliths for the Southeastern-Southern Brazilian region", in this volume we present the results of species of the orders Atheriniformes (1 species), Beloniformes (5), Beryciformes (2), Zeiformes (2), Syngnathiformes (2), Scorpaeniformes (9) and Tetraodontiformes (6). Features, measurements and indices were analyzed according to methodology used in anterior series. Three otoliths of each species have been illustrated and photographed whenever possible. The frequency of occurrence of each characteristic was calculated by total length classes (TL), and differences within and among classes have been analyzed applying the multiple χ^2 test (significance 0.05).

Descriptors: Otoliths, Morphology, Morphometry, Southwestern Atlantic, Brazil.

Resumo

Em adição à série de documentos que estamos publicando sobre o "Atlas de Otólitos para os peixes Teleósteos da região Sudeste-Sul do Brasil", neste volume apresentamos os resultados obtidos para espécies das ordens Atheriniformes (1 espécie), Beloniformes (5), Beryciformes (2), Zeiformes (2), Syngnathiformes (2), Scorpaeniformes (9) e Tetraodontiformes (6). Foram analisadas as feições, medidas e índices usualmente empregados conforme metodologia apresentada nas séries anteriores. Três otólitos de cada espécie foram desenhados e fotografados, sempre que possível. A frequência de ocorrência de cada característica por classe de comprimento total foi calculada (CT) e as diferenças dentro de cada classe e entre classes foram analisadas aplicando teste χ^2 múltiplo (significância 0,05).

Descritores: Otólitos, Morfologia, Morfometria, Atlântico Sudoeste, Brasil.

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INTRODUCTION

Otolith shape analyses are helpful indicators for community, population and individual analysis and environmental events.

Since 2014, as a contribution for these and other studies we have been improving the Collection of Teleostei Fish Otoliths of the Southeastern/Southern Brazilian region (COSS Brasil) held at the Instituto Oceanográfico USP, (IOUSP). Currently, the collection contains 51,886 pairs of otoliths from 66 families, 24 orders and 202 species (ROSSI-WONGTSCHOWSKI et al., 2016). Until now, we published results on the shape of other orders and many families in ROSSI-WONGTSCHOWSKI et al. (2014), SILIPRANDI et al. (2016) and BRENHA-NUNES et al. (2016). These publications will constitute an Atlas of Otoliths of the Southeastern/Southern Brazilian region.

In this volume, we present results of the morphology and morphometry of the otoliths of species belonging to the orders Atheriniformes, Beloniformes, Beryciformes, Zeiformes, Syngnathiformes, Scorpaeniformes and Tetraodontiformes. We hope that our papers and our collection will contribute to all kinds of studies involving otolith morphology.

MATERIAL AND METHODS

The sampled area and the methodology of this study followed that presented in ROSSI-WONGTSCHOWSKI et al. (2014), SILIPRANDI et al. (2016) and BRENHA-NUNES et al. (2016).

The acronyms in the shape indices tables represent: TL=total fish length, OL=otolith length, OH=otolith height and OT=otolith thickness.

RESULTS

Order ATHERINIFORMES

Family ATHERINOPSIDAE

Atherinella brasiliensis (Quoy & Gaimard 1825) - **Plate 1**

Maximum Size:	160 mm (TL) (FROSE; PAULY, 2016).
Distribution:	Western Atlantic, along the South America coast (CARPENTER; MUNROE, 2015).
Habitat:	Benthopelagic; occurs in estuaries, mangroves and soft bottoms (CHERNOFF, 2002).
Diet:	Feeds mainly on zooplankton and diatoms (CONTENTE et al., 2011).
Collection:	1014 otoliths from 541 fishes (TL ranging from 17 to 151 mm).
Sample:	55 left otoliths categorized into 7, 20 mm classes (20 to 160 mm).

Shape: elliptic. ***Anterior region:*** peaked (45%), peaked-round, notched, angled-round. ***Posterior region:*** round (76%), angled, angled-round. ***Dorsal edge:*** lobed (47%), sinuate, entire, lobed to sinuate. ***Ventral edge:*** lobed (44%), sinuate (38%), lobed to entire, entire. ***Profile:*** concave-convex. ***Rostrum and antirostrum orientation*:** in agreement (85%), does not apply. ***Rostrum:*** developed (78%), underdeveloped. ***Antirostrum:*** underdeveloped (60%), developed, absent. ***Pseudorostrum:*** absent. ***Pseudoantirostrum:*** absent. ***Sulcus acusticus:*** *position:* supramedian (73%), median; *orientation:* ascending (76%), horizontal; *opening:* ostial; *morphology:* heterosulcoid; *colliculum:* heteromorphic; *ostium:* elliptic (62%), funnel-like; *cauda:* tubular sinuous.

Statistical differences (p<0.05) within some length classes were obtained for dorsal and ventral edges, anterior and posterior regions, *rostrum* and *antirostrum* development and orientation, *sulcus acusticus* orientation and position and *ostium* morphology. Along the fish growth statistical differences were found for dorsal and ventral edges, anterior and posterior regions, *sulcus acusticus* position and orientation, *ostium* morphology and *rostrum* development.

Shape indices	Mean±Sd	Minimum	Maximum
OL/TL (%)	2.99±0.27	2.64	4.21
OH/OL (%)	60.52±2.85	53.52	68.54
OT/OL (%)	19.41±2.28	16.38	29.21
OT/OH (%)	32.06±3.18	25.82	43.55
Circularity	16.76±1.41	14.82	20.72
Rectangularity	0.73±0.02	0.69	0.77

Order BELONIFORMES

Family HEMIRAMPHIDAE

The anterior region tends to be peaked, the *sulcus acusticus* orientation is ascending, the *ostium* is frequently elliptic and the *cauda* morphology is tubular slightly curved in most of otoliths. The *pseudorostrum* and *pseudoantirostrum* are always absent.

Hemiramphus brasiliensis (Linnaeus 1758) - **Plate 2**

Maximum Size:	550 mm (TL) (SCHNEIDER, 1990).
Distribution:	Western Atlantic, from United States to Brazil and Eastern Atlantic from Canary Islands to Luanda (COLLETTE, 2002a).
Habitat:	Shallow coastal waters, commonly forming schools (FIGUEIREDO; MENEZES, 1978).
Diet:	Feeds on sea grasses and small fishes (FIGUEIREDO; MENEZES, 1978).
Collection:	34 otoliths from 17 fishes (TL ranging from 116 to 200 mm).
Sample:	13 left otoliths categorized into 6, 20 mm classes (100 to 220 mm).

***Shape*:** elliptic to oval. ***Anterior region*:** peaked-round (92%), angled-round. ***Posterior region*:** oblique-round (54%), round, angled. ***Dorsal edge*:** lobed to sinuate (92%), dentate to lobed. ***Ventral edge*:** lobed (62%), lobed to sinuate, dentate to lobed. ***Profile*:** concave-convex. ***Rostrum and antirostrum orientation*:** does not apply. ***Rostrum*:** developed (85%), underdeveloped, absent. ***Antirostrum*:** absent. ***Sulcus acusticus*:** *position:* median; *orientation:* ascending; *opening:* pseudo-ostial; *morphology:* heterosulcoid; *colliculum:* heteromorphic; *ostium:* elliptic (62%), tubular; *cauda:* tubular slightly curved.

Statistical differences (p<0.05) within some length classes were obtained for dorsal edge, anterior region and *rostrum* development. No differences were found along the fish development.

Shape indices	Mean±Sd	Minimum	Maximum
OL/TL (%)	2.20±0.14	1.92	2.51
OH/OL (%)	70.44±3.03	66.42	76.10
OT/OL (%)	16.68±1.09	15.38	19.18
OT/OH (%)	23.69±1.35	21.53	25.93
Circularity	16.14±4.64	0.97	18.77
Rectangularity	0.72±0.02	0.69	0.76

Hyporhamphus roberti (Valenciennes 1847) - **Plate 3**

Maximum Size:	320 mm (TL) (CERVIGÓN et al., 1992).
Distribution:	Central and South America coast, from Panama to Southeastern Brazil (FIGUEIREDO; MENEZES, 1978; COLLETTE, 2002a).
Habitat:	Estuaries and river mouths (COLLETTE, 2002a).
Diet:	Feeds on seagrass, small crustaceans and mollusks (FIGUEIREDO; MENEZES, 1978).
Collection:	2 otoliths from 1 fish (TL: 132 mm).
Sample:	1 left otolith (132 mm).

Shape: elliptic. ***Anterior region:*** peaked. ***Posterior region:*** angled. ***Dorsal edge:*** sinuate. ***Ventral edge:*** entire. ***Profile:*** concave-convex. ***Rostrum and antirostrum orientation:*** does not apply. ***Rostrum:*** underdeveloped. ***Antirostrum:*** absent. ***Sulcus acusticus:*** *position:* median; *orientation:* ascending; *opening:* para-ostial; *morphology:* heterosulcoid; *colliculum:* heteromorphic; *ostium:* elliptic; *cauda:* tubular slightly curved.

Only one otolith was examined not allowing statistical analysis of the data but its morphometric characteristics are shown below:

Shape indices	Mean±Sd	Minimum	Maximum
OL/TL (%)	2.01±0	2.01	2.01
OH/OL (%)	63.77±0	63.77	63.77
OT/OL (%)	16.23±0	16.23	16.23
OT/OH (%)	25.44±0	25.44	25.44
Circularity	14.97±0	14.97	14.97
Rectangularity	0.71±0	0.71	0.71

Hyporhamphus unifasciatus (Ranzani 1841) - **Plate 4**

Maximum Size:	300 mm (TL) (CERVIGÓN et al., 1992).
Distribution:	Western Atlantic, from South Florida to Uruguay (COLLETTE, 2002a).
Habitat:	Inshore surface, forming schools (COLLETTE, 2002a).
Diet:	Feeds on seagrass, small crustaceans and mollusks (FIGUEIREDO; MENEZES, 1978).
Collection:	102 otoliths from 51 fishes (TL ranging from 116 to 282 mm).
Sample:	33 left otoliths categorized into 7, 20 mm classes (100 to 280 mm).

Shape: oval to elliptic (52%), elliptic (48%). ***Anterior region:*** peaked-round. ***Posterior region:*** oblique to angled (73%), oblique-round, oblique, round. ***Dorsal edge***: lobed to sinuate (70%), crenate to entire, sinuate to entire, lobed. ***Ventral edge:*** lobed to sinuate (42%), sinuate to entire, lobed, crenate to entire. ***Profile***: concave-convex. ***Rostrum and antirostrum orientation:*** does not apply (64%), in agreement. ***Rostrum:*** developed. ***Antirostrum***: absent (64%), underdeveloped. ***Sulcus acusticus:*** *position:* median; *orientation:* ascending; *opening:* para-ostial (64%), pseudo-ostial; *morphology:* heterosulcoid; *colliculum:* heteromorphic; *ostium:* elliptic; *cauda:* tubular slightly curved (85%), tubular strongly curved.

Statistical differences (p<0.05) within some length classes were obtained for dorsal edge, posterior region and *cauda* morphology. No differences were found along the fish development.

Shape indices	Mean±Sd	Minimum	Maximum
OL/TL (%)	2.28±0.17	2.05	2.93
OH/OL (%)	67.86±3.76	59.02	74.86
OT/OL (%)	16.22±0.98	14.47	18.40
OT/OH (%)	23.95±1.59	20.66	28.42
Circularity	17.45±1.24	15.16	22.51
Rectangularity	0.71±0.02	0.67	0.75

Family BELONIDAE

The otolith shape is frequently rectangular, although *Strongylura timucu* tends to be elliptic to rectangular. The *rostrum* is always developed and the *ostium* is frequently funnel-like. The *pseudorostrum* and *pseudoantirostrum* are always absent.

Strongylura marina (Walbaum 1792) - **Plate 5**

Maximum Size:	111 mm (TL) (IGFA, 2001), but attaining 621 mm in our collection.
Distribution:	Wester Atlantic, from Maine, USA to Southern Brazil (FIGUEIREDO; MENEZES, 1978).
Habitat:	Coastal areas, mangrove-lined lagoons and also enters fresh water (FIGUEIREDO; MENEZES, 1978; COLLETTE, 2002b).
Diet:	Feeds on small fishes and crustaceans (COLLETTE, 2002b).
Collection:	13 otoliths from 7 fishes (TL ranging from 180 to 621 mm).
Sample:	5 left otoliths categorized into 4, 20 mm classes (280 to 640 mm).

Shape: rectangular (80% - small fish), trapezoidal (large fish). ***Anterior region:*** double-peaked (80%), peaked. ***Posterior region:*** oblique-round (40%), flattened (40%), round. ***Dorsal edge:*** crenate to lobed (40%), lobed to sinuate (40%), crenate to entire. ***Ventral edge:*** lobed (60%), dentate to lobed. ***Profile:*** plane-convex (80%), concave-convex. ***Rostrum and antirostrum orientation:*** in agreement (80%), does not apply. ***Rostrum:*** developed. ***Antirostrum:*** developed (80%), absent. ***Sulcus acusticus:*** *position:* median (80%), supramedian; *orientation:* ascending; *opening:* ostial; *morphology:* heterosulcoid; *colliculum:* heteromorphic; *ostium:* funnel-like (80%), elliptic; *cauda:* tubular straight.

The small number of otoliths examined did not permit the statistical analysis of the data but its morphometric characteristics are shown below:

Shape indices	Mean±Sd	Minimum	Maximum
OL/TL (%)	0.91±0.02	0.88	0.93
OH/OL (%)	55.39±3.44	49.82	59.16
OT/OL (%)	14.29±1.31	12.09	15.22
OT/OH (%)	25.79±1.58	23.87	27.10
Circularity	23.48±1.83	21.62	26.47
Rectangularity	0.72±0.02	0.70	0.76

Strongylura timucu (Walbaum 1792) - **Plate 6**

Maximum Size:	610 mm (TL) (FROESE; PAULY, 2016).
Distribution:	Western Atlantic, from Florida to Southern Brazil (FIGUEIREDO; MENEZES, 1978).
Habitat:	Coastal areas and mangrove-lined lagoons (COLLETTE, 2002b).
Diet:	Feeds on small fishes (COLLETTE, 2002b).
Collection:	5 otoliths from 3 fishes (TL ranging from 121 to 156 mm).
Sample:	3 right otoliths categorized into 2, 20 mm classes (120 to 160 mm).

Shape: elliptic to rectangular (67%), elliptic. ***Anterior region:*** peaked. ***Posterior region:*** round. ***Dorsal edge:*** entire. ***Ventral edge:*** sinuate to entire. ***Profile:*** flattened. ***Rostrum and antirostrum orientation:*** in agreement. ***Rostrum:*** developed. ***Antirostrum:*** underdeveloped. ***Sulcus acusticus:*** *position:* median; *orientation:* horizontal; *opening:* ostial; *morphology:* heterosulcoid; *colliculum:* heteromorphic; *ostium:* funnel-like; *cauda:* tubular slightly curved.

The small number of otoliths examined did not permit the statistical analysis of the data but its morphometric characteristics are shown below:

Shape indices	Mean±Sd	Minimum	Maximum
OL/TL (%)	1.15±0.07	1.12	1.23
OH/OL (%)	55.32±2.39	53.01	57.78
OT/OL (%)	16.86±2.45	14.37	19.26
OT/OH (%)	30.44±3.87	26.04	33.33
Circularity	15.49±0.22	15.27	15.70
Rectangularity	0.76±0.02	0.75	0.78

Order BERYCIFORMES

Family BERYCIDAE

Beryx splendens Lowe 1834 - **Plate 7**

Maximum Size:	700 mm (TL) (SOMMER et al., 1996).
Distribution:	Circumglobal. In the Western Atlantic, from Gulf of Maine to Uruguay (PAXTON, 1999; FROESE; PAULY, 2016).
Habitat:	Benthopelagic, forming dense aggregations (MOORE, 2002a).
Diet:	Feeds on fishes and crustaceans (HORN et al., 2010).
Collection:	236 otoliths from 236 fishes (TL ranging from 169 to 367 mm).
Sample:	29 right otoliths categorized into 8, 20 mm classes (160 to 320 mm).

Shape: trapezoidal. ***Anterior region:*** oblique (90%), oblique to peaked. ***Posterior region***: peaked-round (76%), peaked, oblique-round, oblique. ***Dorsal edge:*** lobed (83%), sinuate. ***Anterior ventral edge:*** lobed (90%), entire, sinuate. ***Posterior ventral edge:*** lobed (79%), sinuate. ***Central ventral edge:*** lobed. ***Profile:*** concave-convex (86%), flattened. ***Rostrum and antirostrum orientation:*** does not apply (86%), in agreement. ***Rostrum:*** developed (86%), underdeveloped. ***Antirostrum:*** absent (86%), underdeveloped. ***Pseudorostrum:*** absent. ***Pseudoantirostrum***: absent. ***Sulcus acusticus:*** *position:* supramedian; *orientation:* ascending (93%), horizontal; *opening:* ostio-caudal (66%), ostial; *morphology:* heterosulcoid; *colliculum:* heteromorphic; *ostium:* bent-concave (93%), tubular; *cauda:* tubular straight.

Statistical differences (p<0.05) within some length classes were obtained for dorsal, ventral and posterior ventral edges, anterior and posterior regions, *rostrum* and *antirostrum* development and orientation, *sulcus acusticus* opening and orientation, *ostium* morphology and profile. No differences were found along the fish development.

Shape indices	Mean±Sd	Minimum	Maximum
OL/TL (%)	4.58±0.29	3.87	5.19
OH/OL (%)	71.40±3.14	66.18	77.88
OT/OL (%)	11.27±1.45	9.19	14.78
OT/OH (%)	15.79±1.95	12.40	20.29
Circularity	21.44±1.61	18.39	24.29
Rectangularity	0.66±0.02	0.61	0.72

Family TRACHICHTHYIDAE

Hoplostethus occidentalis Woods 1973 - **Plate 8**

Maximum Size:	250 mm (TL) (FIGUEIREDO; MENEZES, 1980).
Distribution:	Western Atlantic, from Gulf of Mexico to Southern Brazil (FIGUEIREDO; MENEZES, 1980; MOORE, 2002b).
Habitat:	Benthopelagic, living along slopes at depth of 150 to 550 m (MOORE, 2002b).
Diet:	Feeds on small shrimps (FIGUEIREDO; MENEZES, 1980).
Collection:	318 otoliths from 318 fishes (TL ranging from 93 to 245 mm).
Sample:	57 right otoliths categorized into 8, 20 mm classes (80 to 260 mm).

Shape: trapezoidal to irregular. ***Anterior region:*** oblique (86%), oblique to peaked, flattened. ***Posterior region:*** oblique to angled (82%), oblique, oblique to peaked, flattened to irregular. ***Dorsal edge:*** lobed (42%), sinuate (33%), lobed to sinuate, dentate to lobed. ***Anterior ventral edge:*** entire (47%), sinuate (47%), lobed. ***Posterior ventral edge:*** entire (58%), sinuate, lobed. ***Central ventral edge:*** sinuate (81%), entire. ***Profile***: plane-convex. ***Rostrum and antirostrum orientation:*** in agreement. ***Rostrum:*** developed. ***Antirostrum:*** underdeveloped (72%), developed. ***Pseudorostrum:*** absent. ***Pseudoantirostrum:*** absent. ***Sulcus acusticus:*** *position:* median; *orientation:* horizontal; *opening:* ostial; *morphology:* heterosulcoid; *colliculum:* heteromorphic; *ostium:* discoidal; *cauda:* elliptic.

Statistical differences (p<0.05) within some length classes were obtained for dorsal, anterior ventral, posterior ventral and central ventral edges and anterior and posterior regions. Along the fish growth statistical differences were found for dorsal and ventral edges.

Shape indices	Mean±Sd	Minimum	Maximum
OL/TL (%)	6.23±0.27	5.60	6.91
OH/OL (%)	73.66±3.47	66.58	81.35
OT/OL (%)	16.92±1.63	13.91	20.59
OT/OH (%)	23.03±2.51	17.57	27.61
Circularity	20.95±1.7	18.27	25.86
Rectangularity	0.63±0.03	0.55	0.69

Order ZEIFORMES

Family GRAMMICOLEPIDIDAE

Xenolepidichthys dalgleishi Gilchrist 1922 - **Plate 9**

Maximum Size:	150 mm (TL) (HEEMSTRA, 2002), but attaining 260 mm in our collection.
Distribution:	Western Atlantic, from Nova Scotia to Southern Brazil and Western Pacific (HEEMSTRA, 2002; FIGUEIREDO et al., 2002).
Habitat:	Benthic species, found on the continental slope (FROESE; PAULY, 2016).
Diet:	--
Collection:	1211 otoliths from 658 fishes (TL ranging from 68 to 260 mm).
Sample:	71 left otoliths categorized into 8, 20 mm classes (60 to 260 mm).

Shape: hour-glass. ***Anterior region:*** double-peaked. ***Posterior region:*** double-peaked. ***Dorsal edge:*** lobed (61%), sinuate, lobed to sinuate. ***Ventral edge:*** sinuate (32%), lobed to sinuate (24%), lobed (24%), sinuate to entire. ***Profile***: concave-convex. ***Rostrum and antirostrum orientation***: in agreement. ***Rostrum:*** developed. ***Antirostrum:*** developed. ***Pseudorostrum:*** developed. ***Pseudoantirostrum***: developed. ***Sulcus acusticus:*** *position:* median; *orientation:* horizontal; *opening:* ostio-caudal; *morphology:* homosulcoid; *colliculum:* homomorphic; *ostium:* funnel-like; *cauda:* funnel-like.

Statistical differences (p<0.05) within some length classes were obtained for dorsal and ventral edges. Along the fish's growth statistical differences were found for dorsal and ventral edges.

Shape indices	Mean±Sd	Minimum	Maximum
OL/TL (%)	1.78±0.22	0.95	2.20
OH/OL (%)	102.58±5.01	90.91	112.98
OT/OL (%)	23.33±2.73	18.95	34.35
OT/OH (%)	22.74±2.27	18.75	30.41
Circularity	21.80±2.95	1.85	27.02
Rectangularity	0.65±0.02	0.59	0.70

Family ZENIONTIDAE

Zenion hololepis (Goode & Bean 1896) - **Plate 10**

Maximum Size:	173 mm (TL) (BERNARDES et al., 2005).
Distribution:	Western Atlantic, from Gulf of Mexico to Southeastern Brazil (MENEZES et al., 2003).
Habitat:	Found on tropical waters at depths between 300 to 500 meters (BERNARDES et al., 2005).
Diet:	--
Collection:	422 otoliths from 214 fishes (TL ranging from 56 to 173 mm).
Sample:	27 left otoliths categorized into 7, 20 mm classes (40 to 180 mm).

Shape: bullet-shaped (48%), elliptic (37%), discoidal, rectangular. ***Anterior region:*** round (59%), angled-round, oblique. ***Posterior region:*** flattened (59%), round, oblique. ***Dorsal edge:*** lobed to sinuate (37%), lobed (37%), sinuate to entire, dentate to sinuate. ***Ventral edge:*** entire (96%), lobed, presenting an anterior and posterior projections. ***Profile:*** plane-convex. ***Rostrum and antirostrum orientation:*** does not apply. ***Rostrum:*** absent. ***Antirostrum:*** absent. ***Pseudorostrum:*** absent. ***Pseudoantirostrum:*** absent. ***Sulcus acusticus:*** *position:* median; *orientation:* ascending (70%), horizontal; *opening:* mesial; *morphology:* pseudo-archaesulcoid; *colliculum:* homomorphic; *ostium:* round-oval; *cauda:* round-oval.

Statistical differences (p<0.05) within some length classes were obtained for shape, ventral edge, anterior and posterior regions and *sulcus acusticus* orientation. Along the fish growth statistical differences were found only for anterior region.

Shape indices	Mean±Sd	Minimum	Maximum
OL/TL (%)	3.59±0.66	2.29	4.95
OH/OL (%)	85.62±8.53	71.84	101.01
OT/OL (%)	20.68±1.57	17.97	23.46
OT/OH (%)	24.27±1.85	21.50	29.78
Circularity	19.64±3.57	15.28	28.40
Rectangularity	0.72±0.05	0.62	0.79

Order SYNGNATHIFORMES

Family CENTRISCIDAE

The otoliths of this family is clearly hour-glass, the *pseudorostrum* is always developed and *pseudoantirostrum* is frequently underdeveloped. The *sulcus acusticus* position is supramedial, the opening is ostio-caudal, morphology is homosulcoid, *colliculum* is homomorphic and *ostium* and *cauda* are always funnel-like.

Macroramphosus scolopax (Linnaeus 1758) - **Plate 11**

Maximum Size:	200 mm (TL) (EHRICH, 1990).
Distribution:	Western Atlantic, from Gulf of Maine to Argentina; Eastern Atlantic, Mediterranean, and Indo-West Pacific (FROESE; PAULY, 2016).
Habitat:	Demersal; on the continental shelf over sand bottom (FROESE; PAULY, 2016).
Diet:	Feeds on invertebrates, mainly copepods (EHRICH, 1986).
Collection:	15 otoliths from 10 fishes (TL ranging from 67 to 111 mm).
Sample:	3 left otoliths categorized into 3, 20 mm classes (60 to 100 mm).

Shape: hour-glass. ***Anterior region:*** blunt. ***Posterior region:*** blunt. ***Dorsal edge:*** entire. ***Ventral edge:*** sinuate to entire. ***Profile:*** concave-convex. ***Rostrum and antirostrum orientation:*** in agreement. ***Rostrum:*** developed. ***Antirostrum:*** underdeveloped. ***Pseudorostrum:*** developed. ***Pseudoantirostrum:*** underdeveloped. ***Sulcus acusticus:*** *position:* supramedian; *orientation:* horizontal; *opening:* ostio-caudal; *morphology:* homosulcoid; *colliculum:* homomorphic; *ostium:* funnel-like; *cauda:* funnel-like.

The small number of otoliths examined did not permit the statistical analysis of the data but its morphometric characteristics are shown below:

Shape índices	Mean±Sd	Minimum	Maximum
OL/TL (%)	2.55±1.54	1.05	4.13
OH/OL (%)	95.37±9.44	88.09	106.04
OT/OL (%)	23.24±6.78	18.49	31.00
OT/OH (%)	24.69±8.27	17.44	33.70
Circularity	15.70±0.51	15.16	16.18
Rectangularity	0.67±0.03	0.63	0.69

Notopogon fernandezianus (Delfin 1899) - **Plate 12**

Maximum Size:	188 mm (TL) (FIGUEIREDO; MENEZES, 1980).
Distribution:	Southwest Atlantic, from Southern Brazil to Northern Argentina; Southeast Pacific (FIGUEIREDO; MENEZES, 1980).
Habitat:	Bathydemersal, up to 580 m depth on the continental shelf and slope (FROESE; PAULY, 2016).
Diet:	--
Collection:	21 otoliths from 11 fishes (TL ranging from 142 to 161 mm).
Sample:	6 left otoliths categorized into 2, 20 mm classes (140 to 180 mm).

Shape: hour-glass. ***Anterior region:*** notched (83%), blunt. ***Posterior region:*** notched (67%), blunt. ***Dorsal edge:*** entire. ***Ventral edge***: sinuate (50%), lobed to sinuate (50%). ***Profile:*** concave-convex. ***Rostrum and antirostrum orientation:*** in agreement. ***Rostrum***: developed. ***Antirostrum:*** underdeveloped. ***Pseudorostrum:*** developed. ***Pseudoantirostrum:*** underdeveloped (83%), absent. ***Sulcus acusticus:*** *position:* supramedian; *orientation:* horizontal; *opening:* ostio-caudal; *morphology:* homosulcoid; *colliculum:* homomorphic; *ostium:* funnel-like; *cauda:* funnel-like.

The small number of otoliths examined did not permit the statistical analysis of the data but its morphometric characteristics are shown below:

Shape indices	Mean±Sd	Minimum	Maximum
OL/TL (%)	1.07±0.17	0.93	1.34
OH/OL (%)	102.44±5.58	95.65	109.86
OT/OL (%)	46.97±7.05	38.79	57.63
OT/OH (%)	46.09±8.28	35.90	58.96
Circularity	19.34±1.71	17.65	21.60
Rectangularity	0.61±0.03	0.57	0.65

Order SCORPAENIFORMES

Family TRIGLIDAE

The otolith shape is frequently elliptic and *pseudorostrum* and *pseudoantirostrum* are always absent. The analyzed species present some variation in the *sulcus acusticus* opening which differs from other families.

Bellator brachychir (Regan 1914) - **Plate 13**

Maximum Size:	160 mm (TL) (RICHARDS, 2002), but attaining 208 mm in our collection.
Distribution:	Western Atlantic, from North Carolina to Uruguay (RICHARDS, 2002).
Habitat:	Shallow waters, on bays, estuaries and mid-shelf (FROESE; PAULY, 2016).
Diet:	Feeds on crustaceans and small fishes (SÃO CLEMENTE et al., 2014).
Collection:	83 otoliths from 45 fishes (TL ranging from 34 to 208 mm).
Sample:	19 left otoliths categorized into 3, 20 mm classes (20 to 100 mm).

Shape: elliptic (89%), triangular to elliptic. ***Anterior region:*** blunt to peaked (32%), peaked-round (26%), angled-round (21%), peaked. ***Posterior region:*** flattened (32%), peaked-round (21%), round (21%), peaked. ***Anterior dorsal edge:*** entire (89%), sinuate. ***Posterior dorsal edge:*** does not apply (89%), entire. ***Ventral edge:*** entire (53%), sinuate (47%). ***Profile***: plane-convex. ***Rostrum and antirostrum orientation:*** does not apply (95%), in agreement. ***Rostrum:*** developed. ***Antirostrum:*** absent (95%), underdeveloped. ***Sulcus acusticus:*** *position:* median; *orientation:* horizontal; *opening:* ostial (89%), pseudo-ostial; *morphology:* heterosulcoid; *colliculum:* heteromorphic; *ostium:* elliptic (74%), funnel-like; *cauda:* round-oval.

Statistical differences (p<0.05) within some length classes were obtained for shape, anterior dorsal, posterior dorsal and ventral edges, anterior region, *sulcus acusticus* opening, *antirostrum* development, *rostrum* and *antirostrum* orientation and *ostium* morphology. Along the fish growth statistical differences were found for ventral edge, anterior and posterior regions.

Shape índices	Mean±Sd	Minimum	Maximum
OL/TL (%)	3.64±0.28	3.22	4.21
OH/OL (%)	66.51±5.17	60.12	77.43
OT/OL (%)	20.61±3.62	17.14	29.10
OT/OH (%)	31.23±6.59	25.14	46.99
Circularity	14.49±0.5	13.77	15.33
Rectangularity	0.71±0.02	0.67	0.75

Prionotus nudigula Ginsburg 1950 - **Plate 14**

Maximum Size:	280 mm (TL) (FROESE; PAULY, 2016).
Distribution:	Southwest Atlantic, from Southern Brazil to Argentina (MENEZES et al., 2003; FIGUEIREDO; MENEZES, 1980).
Habitat:	Deep waters from 100 to 400 m depths (FIGUEIREDO et al., 2002).
Diet:	Mainly crustaceans (isopods and shrimps) (SÃO CLEMENTE et al., 2014).
Collection:	627 otoliths from 326 fishes (TL ranging from 68 to 265 mm).
Sample:	95 left otoliths categorized into 11, 20 mm classes (60 to 260 mm).

Shape: elliptic. ***Anterior region:*** angled-round (82%), peaked, peaked-round, round. ***Posterior region:*** angled-round (77%), peaked, round, peaked-round. ***Dorsal edge:*** sinuate (57%), entire, lobed to sinuate, sinuate to entire. ***Ventral edge:*** sinuate (71%), lobed to sinuate, entire, sinuate to entire. ***Profile:*** concave-convex. ***Rostrum and antirostrum orientation:*** in agreement (75%), does not apply. ***Rostrum:*** developed (87%), underdeveloped. ***Antirostrum:*** underdeveloped (74%), absent, developed. ***Sulcus acusticus:*** *position:* median; *orientation:* horizontal; *opening:* ostial (78%), para-ostial, pseudo-ostial, ostio-caudal; *morphology:* heterosulcoid; *colliculum:* heteromorphic; *ostium:* funnel-like (56%), elliptic; *cauda:* tubular markedly curved (64%), tubular strongly curved, round-oval, elliptic.

Significant differences (p<0.05) were obtained within some length classes for dorsal and ventral edges, anterior and posterior regions, *sulcus acusticus* opening and position, *ostium* and *cauda* morphology and *rostrum* and *antirostrum* development and orientation. Along the fish development statistical differences were found for dorsal and ventral edges, *cauda* morphology, *rostrum* and *antirostrum* development and orientation.

Shape indices	Mean±Sd	Minimum	Maximum
OL/TL (%)	3.47±1.43	1.85	7.47
OH/OL (%)	63.50±3.55	54.24	70.36
OT/OL (%)	17.29±1.91	11.72	22.70
OT/OH (%)	27.30±3.2	18.51	34.93
Circularity	14.65±0.44	13.87	16.60
Rectangularity	0.73±0.02	0.68	0.77

Prionotus punctatus (Bloch 1793) - **Plate 15**

Maximum Size:	450 mm (TL) (FROESE; PAULY, 2016).
Distribution:	Western Atlantic, from Belize and Central America to Argentina (FIGUEIREDO et al., 2002).
Habitat:	Found on sand or muddy bottoms of the continental shelves from 5 to 200 m depth (CARVALHO-FILHO, 1992).
Diet:	Nocturnal habits, feeds mainly on crustaceans (SOARES; APELBAUM, 1994).
Collection:	736 otoliths from 394 fishes (TL ranging from 7 to 422 mm).
Sample:	59 left otoliths categorized into 14, 20 mm classes (20 to 380 mm).

Shape: elliptic. ***Anterior region:*** peaked (73%), angled-round, peaked-round. ***Posterior region:*** round (51%), angled-round, peaked, flattened. ***Dorsal edge:*** lobed to sinuate (44%), dentate to lobed, lobed, sinuate to entire. ***Ventral edge:*** lobed to sinuate (34%), lobed (31%), dentate to lobed (27%), sinuate to entire. ***Profile:*** concave-convex. ***Rostrum and antirostrum orientation:*** does not apply (97%), in agreement. ***Rostrum:*** developed. ***Antirostrum:*** absent (97%), underdeveloped. ***Sulcus acusticus:*** *position:* median; *orientation:* horizontal; *opening:* pseudo-ostial (71%), ostial; *morphology:* heterosulcoid; *colliculum:* heteromorphic; *ostium:* elliptic (53%), tubular, funnel-like; *cauda:* tubular strongly curved (71%), tubular markedly curved.

Significant differences ($p<0.05$) were obtained within some length classes for dorsal and ventral edges, anterior and posterior regions, *sulcus acusticus* opening, *ostium* and *cauda* morphology, *antirostrum* development and *rostrum* and *antirostrum* orientation. Along the fish development statistical differences were found only for the *ostium* morphology.

Shape índices	Mean±Sd	Minimum	Maximum
OL/TL (%)	3.23±0.39	2.36	4.19
OH/OL (%)	66.15±2.36	59.61	71.02
OT/OL (%)	14.84±2.23	10.17	20.23
OT/OH (%)	22.43±3.27	16.34	30.17
Circularity	18.66±2.29	14.30	24.40
Rectangularity	0.69±0.02	0.66	0.73

Family DACTYLOPTERIDAE

Dactylopterus volitans (Linnaeus 1758) - **Plate 16**

Maximum Size:	500 mm (TL) (FROESE; PAULY, 2016).
Distribution:	Eastern and Western Atlantic, from Bermuda to Argentina (FIGUEIREDO; MENEZES, 1980).
Habitat:	Found on sand and mud bottoms near rocky areas and reefs, exploring the bottom with the pectoral fins (CARVALHO-FILHO, 1992).
Diet:	Feeds mainly on crustaceans, mollusks and small fishes (BERNARDES et al., 2005).
Collection:	2571 otoliths from 1426 fishes (TL ranging from 65 to 292 mm).
Sample:	106 left otoliths categorized into 12, 20 mm classes (60 to 280 mm).

Shape: oval (80%), discoidal, elliptic, hour-glass. ***Anterior region:*** double-peaked (62%), peaked-round, blunt, angled. ***Posterior region:*** oblique-round (50%), round (44%), blunt, flattened. ***Dorsal edge:*** entire (94%), sinuate, lobed, crenate. ***Ventral edge:*** entire (42%), sinuate, crenate, lobed. ***Profile:*** plane-convex. ***Rostrum and antirostrum orientation:*** in agreement. ***Rostrum:*** developed (67%), underdeveloped. ***Antirostrum:*** underdeveloped (51%), developed (49%). ***Pseudorostrum:*** absent (98%), underdeveloped, developed. ***Pseudoantirostrum:*** absent (98%), underdeveloped, developed. ***Sulcus acusticus:*** *position:* median; *orientation:* horizontal; *opening:* ostial (95%), ostio-caudal; *morphology:* heterosulcoid; *colliculum:* heteromorphic; *ostium:* funnel-like; *cauda:* tubular markedly curved (90%), tubular strongly curved, round-oval.

Significant differences (p<0.05) were obtained within some length classes for shape, dorsal and ventral edges, anterior and posterior regions, *sulcus acusticus* opening, *cauda* morphology and *rostrum*, *antirostrum*, *pseudorostrum* and *pseudoantirostrum* development. Along the otoliths growth statistical differences were found for ventral edge, anterior and posterior regions and *rostrum* and *antirostrum* development.

Shape indices	Mean±Sd	Minimum	Maximum
OL/TL (%)	1.15±0.19	0.77	1.65
OH/OL (%)	77.04±5.8	63.27	95.24
OT/OL (%)	31.82±3.7	25.28	44.44
OT/OH (%)	41.30±3.58	33.85	52.83
Circularity	16.66±2.5	13.38	25.13
Rectangularity	0.71±0.03	0.62	0.80

Family SEBASTIDAE

Helicolenus lahillei Norman 1937 - **Plate 17**

Maximum Size:	462 mm (TL) (BERNARDES et al., 2005).
Distribution:	Southwest Atlantic, from Rio Grande do Sul to Argentina (MENEZES et al., 2003).
Habitat:	Demersal species, found on deep waters (FIGUEIREDO et al., 2002).
Diet:	Feeds on crustaceans, mollusks and small fishes (BERNARDES et al., 2005).
Collection:	348 otoliths from 339 fishes (TL ranging from 61 to 462 mm).
Sample:	96 left otoliths categorized into 18, 20 mm classes (60 to 460 mm).

Shape: elliptic (79%), fusiform, elliptic to lanceolated, fusiform to lanceolated. ***Anterior region:*** peaked (91%), lanceolated. ***Posterior region:*** round (32%), oblique-round (26%), flattened, peaked. ***Dorsal edge:*** entire (45%), sinuate (41%), lobed, lobed to sinuate. ***Ventral edge:*** sinuate (39%), lobed to sinuate (35%), serrate to entire, entire. ***Profile:*** concave-convex. ***Rostrum and antirostrum orientation:*** in agreement (60%), does not apply. ***Rostrum:*** developed (98%), absent. ***Antirostrum:*** underdeveloped (60%), absent. ***Pseudorostrum:*** absent. ***Pseudoantirostrum:*** absent. ***Sulcus acusticus:*** *position:* inframedian (67%), median; *orientation:* horizontal; *opening:* ostial (93%), para-ostial, pseudo-ostial; *morphology:* heterosulcoid; *colliculum:* heteromorphic; *ostium:* funnel-like (90%), elliptic; *cauda:* tubular straight (52%), tubular slightly curved (48%).

Significant differences (p<0.05) were obtained within some length classes for shape, dorsal and ventral edges, anterior and posterior regions, *sulcus acusticus* opening and position, *ostium* and *cauda* morphology and *rostrum* development. Along the fish development statistical differences were found for dorsal and ventral edges, posterior region, *sulcus acusticus* position and *cauda* morphology.

Shape indices	Mean±Sd	Minimum	Maximum
OL/TL (%)	4.08±0.5	2.78	5.38
OH/OL (%)	53.44±2.69	46.35	60.19
OT/OL (%)	14.64±2.2	11.62	23.15
OT/OH (%)	27.46±4.4	21.72	44.23
Circularity	18.07±1.73	15.82	24.49
Rectangularity	0.66±0.02	0.59	0.70

Family PERISTEDIIDAE

Peristedion altipinne (Regan 1903) - **Plate 18**

Maximum Size:	260 mm (TL) (BERNARDES et al., 2005).
Distribution:	Southwest Atlantic, from Rio de Janeiro to Rio Grande do Sul (FIGUEIREDO et al., 2002).
Habitat:	Inhabits deep waters of the continental shelf, between 100 to 200 m depth (BERNARDES et al., 2005).
Diet:	--
Collection:	339 otoliths from 188 fishes (TL ranging from 112 to 258 mm).
Sample:	55 left otoliths categorized into 7, 20 mm classes (120 to 240 mm).

Shape: elliptic (56%), oval. ***Anterior region:*** double-peaked (33%), peaked, blunt, round. ***Posterior region:*** round (35%), angled-round (33%), angled, oblique. ***Dorsal edge:*** sinuate (76%), entire, lobed to sinuate. ***Ventral edge:*** sinuate (82%), entire, lobed to sinuate. ***Profile:*** concave-convex. ***Rostrum and antirostrum orientation:*** in agreement (69%), does not apply. ***Rostrum:*** underdeveloped (65%), developed, absent. ***Antirostrum:*** underdeveloped (56%), absent, developed. ***Pseudorostrum:*** absent. ***Pseudoantirostrum:*** absent (98%), underdeveloped. ***Sulcus acusticus:*** *position:* median (69%), inframedian; *orientation:* horizontal; *opening:* ostial (85%), pseudo-ostial, para-ostial, ostio-caudal *morphology:* heterosulcoid; *colliculum:* heteromorphic; *ostium:* elliptic (95%), funnel-like; *cauda:* tubular straight (93%), tubular strongly curved, tubular slightly curved.

Significant differences (p<0.05) were obtained within some length classes for shape, dorsal and ventral edges, anterior and posterior regions, *sulcus acusticus* opening and position, *ostium* and *cauda* morphology and *rostrum* and *pseudoantirostrum* development. Along the otolith growth statistical differences were found for shape, anterior region and *sulcus acusticus* position.

Shape indices	Mean±Sd	Minimum	Maximum
OL/TL (%)	1.79±0.16	1.49	2.38
OH/OL (%)	73.32±5.38	60.13	84.15
OT/OL (%)	20.47±2.00	17.13	25.88
OT/OH (%)	28.01±2.9	22.83	35.38
Circularity	14.96±1.06	13.44	18.67
Rectangularity	0.71±0.02	0.65	0.76

Family SCORPAENIDAE

The two species of this family are very different from each other and presented no common features. The *pseudorostrum* and *pseudoantirostrum* are always absent.

Pontinus rathbuni Goode & Bean 1896 - **Plate 19**

Maximum Size:	250 mm (TL) (FROESE; PAULY, 2016).
Distribution:	Western Atlantic, from Rio de Janeiro to Southern Brazil (MENEZES et al., 2003). FIGUEIREDO & MENEZES (1980) treat the species as a synonym of *Pontinus corallinus*.
Habitat:	Demersal species, found at depths between 90 to 215 meters (BERNARDES et al., 2005)
Diet:	--
Collection:	2 otoliths from 1 fish (TL ranging 97 mm).
Sample:	1 left otolith categorized into 1, 20 mm classes (97 mm).

Shape: elliptic. ***Anterior region:*** peaked-round. ***Posterior region:*** peaked. ***Dorsal edge:*** entire. ***Ventral edge:*** sinuate to entire. ***Profile:*** plane-convex. ***Rostrum and antirostrum orientation:*** in agreement. ***Rostrum:*** developed. ***Antirostrum:*** underdeveloped. ***Sulcus acusticus:*** *position:* median; *orientation:* horizontal; *opening:* para-ostial; *morphology:* heterosulcoid; *colliculum:* heteromorphic; *ostium:* elliptic; *cauda:* tubular strongly curved.

The small number of otoliths examined did not allow the statistical analysis of the data but its morphometric characteristics are shown below:

Shape indices	Mean±Sd	Minimum	Maximum
OL/TL (%)	5.43±0	5.43	5.43
OH/OL (%)	54.27±0	54.27	54.27
OT/OL (%)	19.54±0	19.54	19.54
OT/OH (%)	36.01±0	36.01	36.01
Circularity	16.02±0	16.02	16.02
Rectangularity	0.68±0	0.68	0.68

Scorpaena dispar Longley & Hildebrand 1940 - **Plate 20**

Maximum Size:	272 mm (TL) (FIGUEIREDO; MENEZES, 1980).
Distribution:	Western Atlantic, from Florida to Rio de Janeiro, Brazil (MENEZES et al., 2003).
Habitat:	Inhabits offshore waters at depths between 30 to 120 meters (CARVALHO-FILHO, 1992).
Diet:	--
Collection:	4 otoliths from 2 fishes (TL ranging from 38 to 129 mm).
Sample:	2 right otoliths categorized into 2, 20 mm classes (20 to 120 mm).

Shape: elliptic. ***Anterior region:*** peaked. ***Posterior region:*** round (50%), peaked (50%). ***Dorsal edge:*** sinuate to entire. ***Ventral edge:*** entire (50%), sinuate to entire (50%). ***Profile:*** concave-convex (50%), biconvex (50%). ***Rostrum and antirostrum orientation:*** does not apply. ***Rostrum:*** developed. ***Antirostrum:*** absent. ***Sulcus acusticus:*** *position:* median; *orientation;* horizontal; *opening:* ostial; *morphology:* heterosulcoid; *colliculum:* heteromorphic; *ostium:* elliptic; *cauda:* tubular slightly curved (50%), round-oval (50%).

The small number of otoliths examined did not permit the statistical analysis of the data but its morphometric characteristics are shown below:

Shape índices	Mean±Sd	Minimum	Maximum
OL/TL (%)	5.97±0.57	5.57	6.37
OH/OL (%)	53.58±5.46	49.72	57.44
OT/OL (%)	22.13±8.45	16.16	28.10
OT/OH (%)	40.71±11.62	32.49	48.92
Circularity	15.97±1.25	15.09	16.85
Rectangularity	0.68±0.03	0.66	0.70

Family SETARCHIDAE

Setarches guentheri Johnson 1862 - **Plate 21**

Maximum Size:	250 mm (TL) (FROESE; PAULY, 2016), but attaining 255 mm in our collection.
Distribution:	Eastern and Western Atlantic, from USA to Southern Brazil. Also occurs in the Indo-West and Eastern Pacific (FIGUEIREDO et al., 2002; MENEZES et al., 2003).
Habitat:	Inhabits offshore waters living on or near to the bottom (FIGUEIREDO et al., 2002).
Diet:	Feeds mainly on bathypelagic crustaceans (FROESE; PAULY, 2016).
Collection:	944 otoliths from 477 fishes (TL ranging from 43 to 255 mm).
Sample:	100 left otoliths categorized into 11, 20 mm classes (40 to 240 mm).

Shape: elliptic (65%), elliptic to lanceolated, fusiform to lanceolated, elliptic to cuneiform. ***Anterior region:*** peaked (50%), lanceolated-round, peaked-round, lanceolated. ***Posterior region:*** round (74%), angled-round, flattened, double-peaked. ***Dorsal edge:*** lobed (36%), lobed to sinuate (34%), sinuate (27%), entire. ***Ventral edge:*** sinuate (55%), entire, lobed to sinuate, sinuate to entire. ***Profile:*** flattened (64%), plane-convex. ***Rostrum and antirostrum orientation:*** in agreement (84%), does not apply. ***Rostrum:*** developed. ***Antirostrum:*** underdeveloped (67%), developed, absent. ***Pseudorostrum:*** absent (99%), underdeveloped. ***Pseudoantirostrum:*** absent (99%), underdeveloped. ***Sulcus acusticus:*** *position:* median; *orientation:* horizontal; *opening:* ostial (99%), ostio-caudal; *morphology:* pseudo-archaesulcoid; *colliculum:* heteromorphic; *ostium:* funnel-like; *cauda:* elliptic.

Significant differences ($p<0.05$) were obtained within some length classes for shape, profile, dorsal and ventral edges, anterior and posterior regions, *sulcus acusticus* opening, *ostium* and *cauda* morphology, *antirostrum*, *pseudorostrum* and *pseudoantirostrum* development and *rostrum* and *antirostrum* orientation. Along the fish development statistical differences were found for shape, profile, dorsal and ventral edges and anterior region.

Shape indices	Mean±Sd	Minimum	Maximum
OL/TL (%)	4.83±0.38	3.05	5.88
OH/OL (%)	61.51±5.96	34.38	73.47
OT/OL (%)	18.59±2.57	13.76	25.44
OT/OH (%)	30.32±3.9	23.42	58.04
Circularity	17.73±2.33	4.61	23.95
Rectangularity	0.67±0.06	0.62	0.72

Order TETRAODONTIFORMES

Family DIODONTIDAE

Chilomycterus spinosus (Linnaeus 1758) - **Plate 22**

Maximum Size:	350 mm (TL) (BERNARDES et al., 2005).
Distribution:	Southwest Atlantic, from Bahia to Argentina (MENEZES et al., 2003; FIGUEIREDO et al., 2002).
Habitat:	Found on estuarine waters to 190 m depth (FIGUEIREDO; MENEZES, 2000).
Diet:	Feeds mainly on invertebrates (bivalves, barnacles, polychaetes) (ALMEIDA-SILVA et al., 2015).
Collection:	150 otoliths from 86 fishes (TL ranging from 40 to 190 mm).
Sample:	13 left otoliths categorized into 3, 20 mm classes (40 to 80 mm).

Shape: discoidal (58%), tall, irregular. ***Anterior region:*** round (69%), double-peaked, notched, flattened. ***Posterior region:*** round. ***Dorsal edge:*** entire (62%), sinuate. ***Ventral edge:*** entire (62%), sinuate. ***Profile:*** plane-convex. ***Rostrum and antirostrum orientation:*** does not apply (92%), in agreement. ***Rostrum:*** absent. ***Antirostrum:*** absent (92%), underdeveloped. ***Pseudorostrum***: absent. ***Pseudoantirostrum***: absent. ***Sulcus acusticus:*** *position:* inframedian; *orientation:* horizontal; *opening:* ostio-caudal (92%), ostial; *morphology:* pseudo-archaesulcoid; *colliculum:* monomorphic; *ostium:* tubular (54%), funnel-like (46%); *cauda:* tubular markedly curved (62%), tubular straight.

Significant differences ($p<0.05$) were obtained within some length classes for shape, dorsal and ventral edges, anterior region, *sulcus acusticus* opening, *antirostrum* development and *rostrum* and *antirostrum* orientation. Along the otolith growth statistical differences were found for dorsal and ventral edges.

Shape indices	Mean±Sd	Minimum	Maximum
OL/TL (%)	0.85±0.16	0.62	1.19
OH/OL (%)	117.93±10.21	96.10	135.71
OT/OL (%)	44.61±6.19	33.33	54.76
OT/OH (%)	37.97±5.49	29.41	47.92
Circularity	14.49±1.56	13.16	17.87
Rectangularity	0.76±0.06	0.68	0.85

Diodon holocanthus Linnaeus 1758 - **Plate 23**

Maximum Size:	500 mm (TL) (CARVALHO-FILHO, 1992).
Distribution:	Circumtropical. In the Western Atlantic, from Florida to Southern Brazil (MENEZES et al., 2003).
Habitat:	Inhabits algae bottoms and estuarine areas, also found in areas with rocky bottoms (CARVALHO-FILHO, 1992).
Diet:	Feeds mainly on bivalves, gastropods and crustaceans (HUIZAR; CARRARA, 2000).
Collection:	4 otoliths from 2 fishes (TL ranging from 106 to 111 mm).
Sample:	2 left otoliths categorized into 1, 20 mm classes (100 mm).

Shape: tall. ***Anterior region:*** peaked. ***Posterior region:*** round. ***Dorsal edge:*** sinuate (50%), lobed (50%). ***Ventral edge:*** sinuate (50%), entire (50%). ***Profile:*** concave-convex. ***Rostrum and antirostrum orientation:*** in agreement. ***Rostrum:*** developed. ***Antirostrum:*** underdeveloped. ***Pseudorostrum:*** absent. ***Pseudoantirostrum:*** absent. ***Pseudorostrum***: absent. ***Pseudoantirostrum***: absent. ***Sulcus acusticus:*** *position:* supramedian; *orientation:* horizontal (50%), descending (50%); *opening:* ostial; *morphology:* heterosulcoid; *colliculum:* heteromorphic; *ostium:* funnel-like; *cauda* round-oval.

The small number of otoliths examined did not allow the statistical analysis of the data but its morphometric characteristics are shown below:

Shape indices	Mean±Sd	Minimum	Maximum
OL/TL (%)	0.70±0.05	0.67	0.74
OH/OL (%)	131.84±14.21	121.79	141.89
OT/OL (%)	54.02±3.87	51.28	56.76
OT/OH (%)	41.05±1.49	40.00	42.11
Circularity	15.22±0.54	14.83	15.60
Rectangularity	0.76±0.05	0.73	0.80

Family TETRAODONTIDAE

The otolith of this family is clearly hour-glass the *sulcus acusticus* position is medial, the orientation is horizontal, morphology is homosulcoid, *colliculum* is homomorphic and *ostium* and *cauda* are always funnel-like.

Lagocephalus laevigatus (Linnaeus 1766) - **Plate 24**

Maximum Size:	1000 mm (TL) (FIGUEIREDO et al., 2002).
Distribution:	Eastern and Western Atlantic, from New England to Argentina (FIGUEIREDO; MENEZES, 2000; FIGUEIREDO et al., 2002).
Habitat:	Juveniles inhabit inshore areas over sand or mud bottoms; adults are pelagic found on continental margins (CARVALHO-FILHO, 1992).
Diet:	Feeds mostly on crustaceans and fishes (DENADAI et al., 2012).
Collection:	1 otolith from 1 fish (TL ranging 144 mm).
Sample:	1 left otolith categorized into 1, 20 mm classes (140 mm).

Shape: hour-glass. ***Anterior region:*** notched. ***Posterior region:*** notched. ***Dorsal edge:*** lobed to sinuate. ***Ventral edge:*** lobed to sinuate. ***Profile:*** concaveconvex. ***Rostrum and antirostrum orientation:*** in agreement. ***Rostrum:*** developed. ***Antirostrum:*** developed. ***Pseudorostrum:*** underdeveloped. ***Pseudoantirostrum:*** underdeveloped. ***Sulcus acusticus:*** *position:* median; *orientation:* horizontal; *opening:* ostio-caudal; *morphology:* homosulcoid; *colliculum:* homomorphic; *ostium:* funnel-like; *cauda:* funnel-like.

The small number of otoliths examined did not permit the statistical analysis of the data but it morphometric characteristics are shown below:

Shape indices	Mean±Sd	Minimum	Maximum
OL/TL (%)	0.53±0	0.53	0.53
OH/OL (%)	103.95±0	103.95	103.95
OT/OL (%)	32.89±0	32.89	32.89
OT/OH (%)	31.65±0	31.65	31.65
Circularity	21.27±0	21.27	21.27
Rectangularity	0.65±0	0.65	0.65

Sphoeroides greeleyi Gilbert 1900 - **Plate 25**

Maximum Size:	180 mm (TL) (CERVIGÓN et al., 1992).
Distribution:	Western Atlantic, from Honduras to Southern Brazil (MENEZES et al., 2003).
Habitat:	Found on bays and estuarine waters over soft bottoms (FIGUEIREDO; MENEZES, 2000).
Diet:	Feeds on marine invertebrates (FIGUEIREDO; MENEZES, 2000).
Collection:	119 otoliths from 69 fishes (TL ranging from 51 to 145 mm).
Sample:	23 left otoliths categorized into 5, 20 mm classes (60 to 140 mm).

Shape: hour-glass (87%), trapezoidal to elliptic. ***Anterior region:*** double-peaked-round (52%), double-peaked (43%), angled-round. ***Posterior region:*** double-peaked-round (61%), oblique to angled, oblique-round. ***Dorsal edge:*** entire (61%), lobed. ***Ventral edge:*** entire (61%), sinuate to entire. ***Profile:*** planeconvex. ***Rostrum and antirostrum orientation:*** in agreement. ***Rostrum:*** developed (96%), underdeveloped. ***Antirostrum:*** underdeveloped (74%), developed. ***Pseudorostrum:*** developed (74%), underdeveloped, absent. ***Pseudoantirostrum:*** underdeveloped (74%), absent. ***Sulcus acusticus:*** *position:* median; *orientation:* horizontal; *opening:* ostio-caudal; *morphology:* homosulcoid; *colliculum:* homomorphic; *ostium:* funnel-like; *cauda:* funnel-like.

Significant differences (p<0.05) were obtained within some length classes for shape, dorsal and ventral edges, anterior and posterior regions and *rostrum*, *antirostrum*, *pseudorostrum* and *pseudoantirostrum* development. Along the fish's development statistical differences were found for dorsal and ventral edges, anterior and posterior regions and *pseudoantirostrum* development.

Shape índices	Mean±Sd	Minimum	Maximum
OL/TL (%)	1.05±0.12	0.74	1.26
OH/OL (%)	89.63±5.72	80.95	105.06
OT/OL (%)	39.18±4.43	32.11	49.37
OT/OH (%)	43.69±3.83	36.08	51.76
Circularity	17.91±4.63	14.00	33.33
Rectangularity	0.65±0.05	0.52	0.71

Sphoeroides testudineus (Linnaeus 1758) - **Plate 26**

Maximum Size:	388 mm (TL) (FROESE; PAULY, 2016).
Distribution:	Western Atlantic, from New Jersey to Southern Brazil (MENEZES et al., 2003).
Habitat:	Commonly found in bays and protected coastal waters being rare or absent in coral reefs (CARVALHO-FILHO, 1992; FIGUEIREDO; MENEZES, 2000).
Diet:	Feeds mainly on bivalves, gastropods and other benthic invertebrates (CHI-ESPÍNOLA; VEGA-CENDEJAS, 2013).
Collection:	9 otoliths from 5 fishes (TL ranging from 79 to 232 mm).
Sample:	2 left otoliths categorized into 2, 20 mm classes (80 to 200 mm).

Shape: hour-glass. ***Anterior region:*** blunt to peaked (50%), double-peaked (50%). ***Posterior region:*** blunt-round. ***Dorsal edge:*** sinuate to entire. ***Ventral edge:*** entire (50%), sinuate to entire (50%). ***Profile:*** plane-convex. ***Rostrum and antirostrum orientation:*** in agreement. ***Rostrum:*** developed. ***Antirostrum:*** underdeveloped (50%), developed (50%). ***Pseudorostrum:*** underdeveloped. ***Pseudoantirostrum:*** underdeveloped. ***Sulcus acusticus:*** *position:* median; *orientation:* horizontal; *opening:* ostio-caudal; *morphology:* homosulcoid; *colliculum:* homomorphic; *ostium:* funnel-like; *cauda:* funnel-like.

The small number of otoliths examined did not allow the statistical analysis of the data but its morphometric characteristics are shown below:

Shape indices	Mean±Sd	Minimum	Maximum
OL/TL (%)	1.10±0.49	0.75	1.45
OH/OL (%)	87.28±3.85	84.56	90.00
OT/OL (%)	32.46±12.32	23.75	41.18
OT/OH (%)	37.54±15.77	26.39	48.70
Circularity	16.48±1.13	15.68	17.28
Rectangularity	0.64±0	0.64	0.64

Family MONACANTHIDAE

Stephanolepis hispidus (Linnaeus 1766) - **Plate 27**

Maximum Size:	300 mm (TL) (CARVALHO-FILHO, 1992).
Distribution:	Eastern and Western Atlantic, from Nova Scotia to Uruguay (FIGUEIREDO et al., 2002; MENEZES et al., 2003).
Habitat:	Found on coastal waters especially on rocky, reef and algae bottoms (CARVALHO-FILHO, 1992).
Diet:	Feeds on benthic invertebrates (FROESE; PAULY, 2016).
Collection:	22 otoliths from 13 fishes (TL ranging from 36 to 195 mm).
Sample:	4 left otoliths categorized into 3, 20 mm classes (20 to 180 mm).

Shape: hour-glass. ***Anterior region:*** notched (75%), blunt to angled. ***Posterior region:*** notched (50%), blunt (50%). ***Dorsal edge:*** entire. ***Ventral edge:*** entire. ***Profile:*** plane-convex. ***Rostrum and antirostrum orientation:*** in agreement. ***Rostrum:*** underdeveloped (75%), developed. ***Antirostrum:*** underdeveloped (75%), developed. ***Pseudorostrum:*** underdeveloped (75%), developed. ***Pseudoantirostrum:*** underdeveloped (75%), developed. ***Sulcus acusticus:*** *position:* median; *orientation:* horizontal; *opening:* ostio-caudal; *morphology:* homosulcoid; *colliculum:* homomorphic; *ostium:* funnel-like; *cauda:* funnel-like.

The small number of otoliths examined did not permit the statistical analysis of the data but its morphometric characteristics are shown below:

Shape indices	Mean±Sd	Minimum	Maximum
OL/TL (%)	1.10±0.31	0.70	1.46
OH/OL (%)	112.93±10.68	98.54	121.43
OT/OL (%)	34.52±3.23	32.12	39.29
OT/OH (%)	30.64±2.32	27.63	32.59
Circularity	18.51±5.61	15.22	26.90
Rectangularity	0.69±0.05	0.63	0.74

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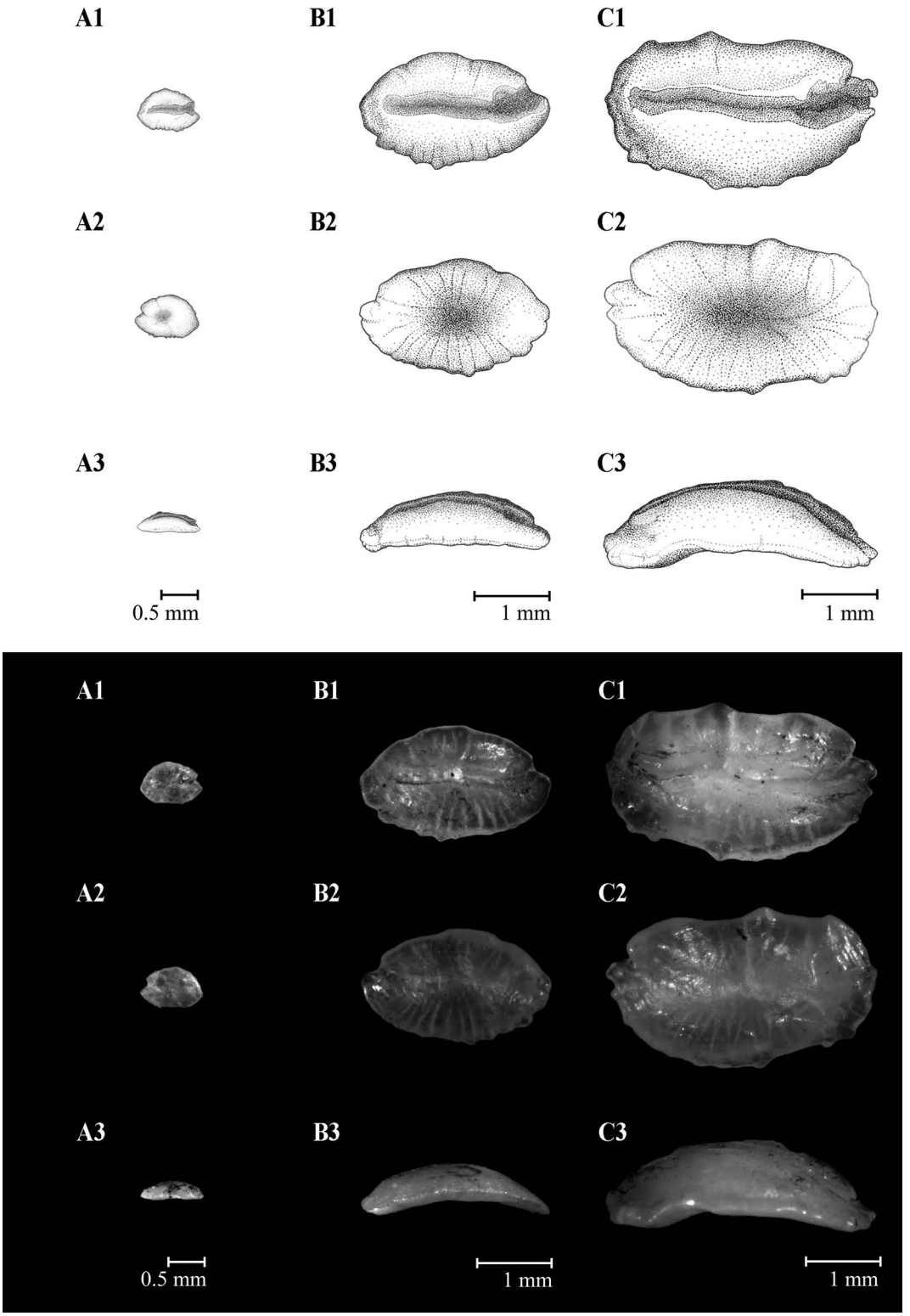


Plate 1. Illustrations (above) and photographs (below) of *Atherinella brasiliensis* otoliths from fish with total length: A. 32 mm; B. 86 mm; C. 141mm. The medial face is shown in A1; B1; C1; the lateral face in A2; B2; C2; and the ventral profile in A3; B3, C3 (Illustration: Laura Montserrat; Photos: Cesar Santificetur).

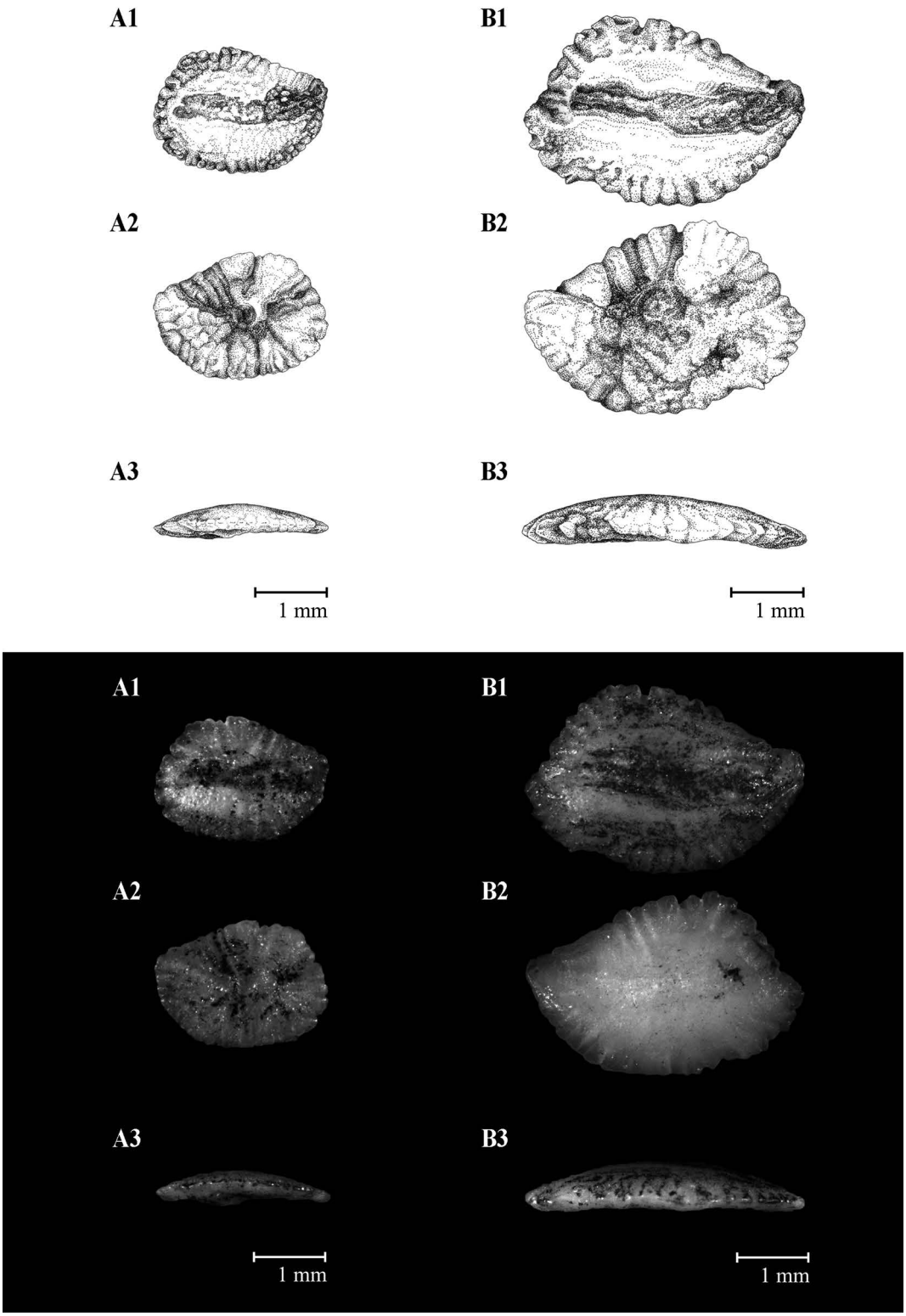


Plate 2. Illustrations (above) and photographs (below) of *Hemiramphus brasiliensis* otoliths from fish with total length: A. 116 mm; B. 200 mm. The medial face is shown in A1; B1; the lateral face in A2; B2; and the ventral profile in A3; B3 (Illustration: Sílvia de Almeida Gonsales; Photos: Cesar Santificetur).

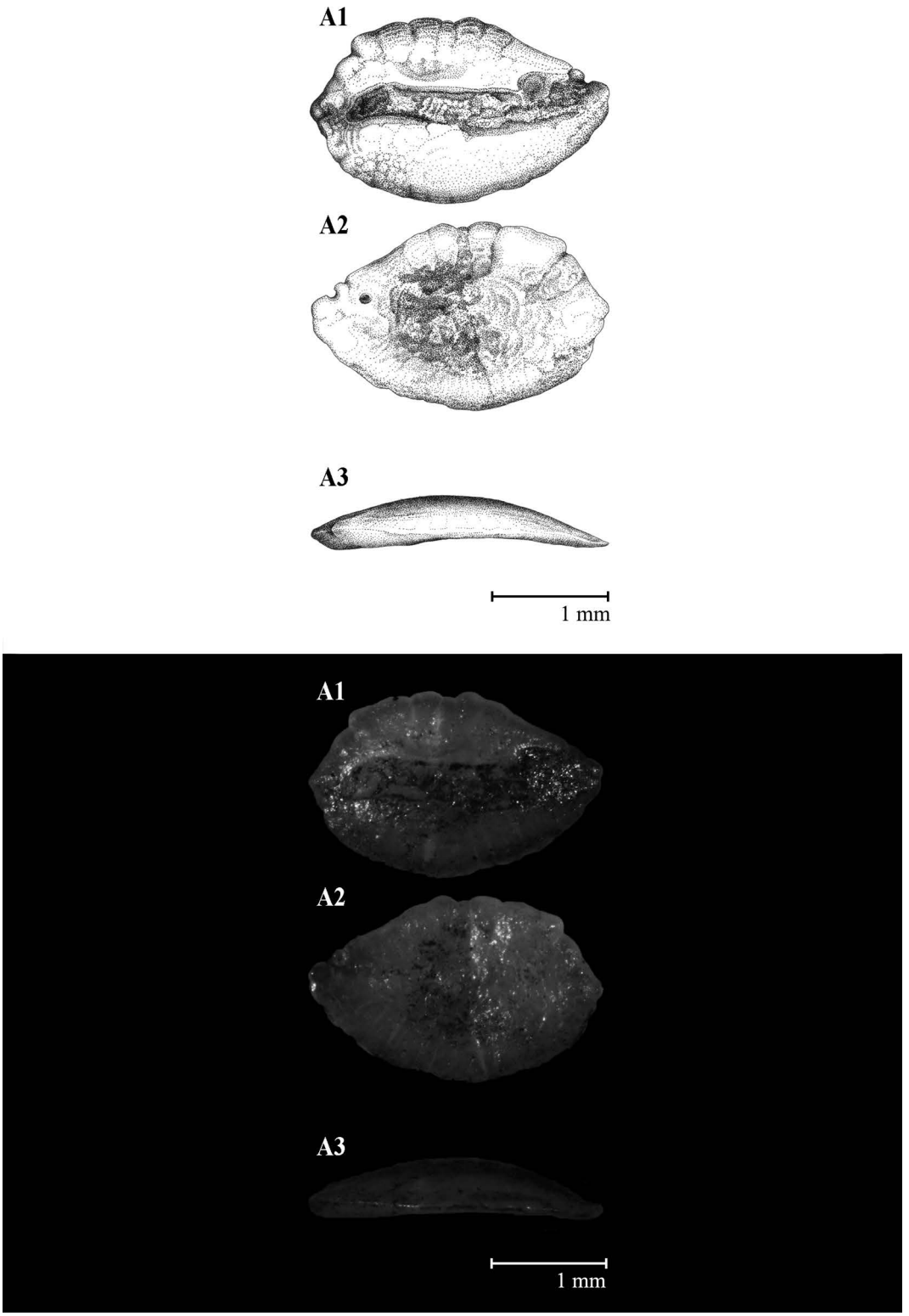


Plate 3. Illustrations (above) and photographs (below) of *Hyporhamphus roberti* otolith from fish with total length: A. 132 mm. The medial face is shown in A1; the lateral face in A2; and the ventral profile in A3 (Illustration: Sílvia de Almeida Gonsales; Photos: Cesar Santificetur).

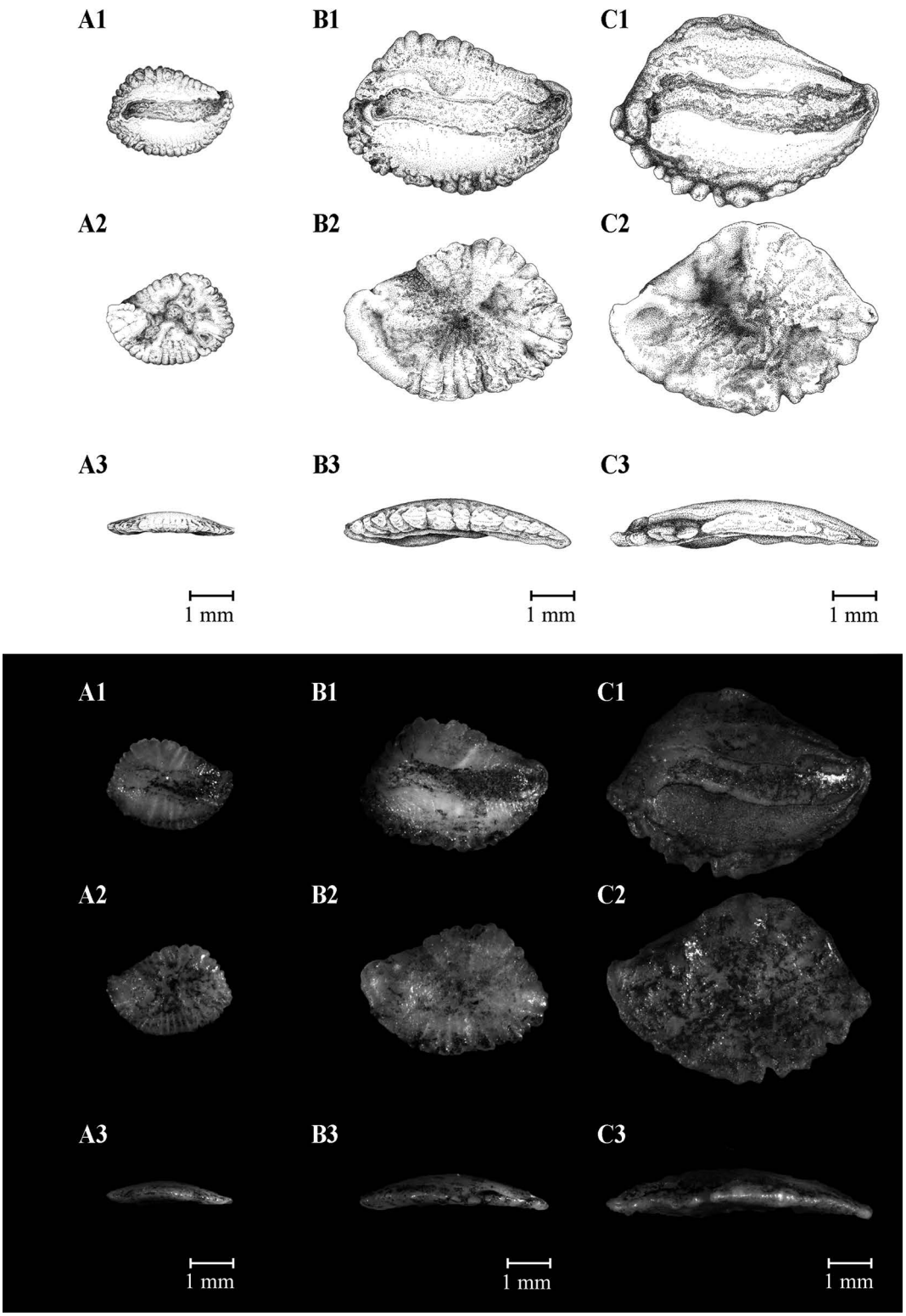


Plate 4. Illustrations (above) and photographs (below) of *Hyporhamphus unifasciatus* otoliths from fish with total length: A. 116 mm; B. 190 mm; C. 261 mm. The medial face is shown in A1; B1; C1; the lateral face in A2; B2; C2; and the ventral profile in A3; B3; C3 (Illustration: Sílvia de Almeida Gonsales; Photos: Cesar Santificetur).

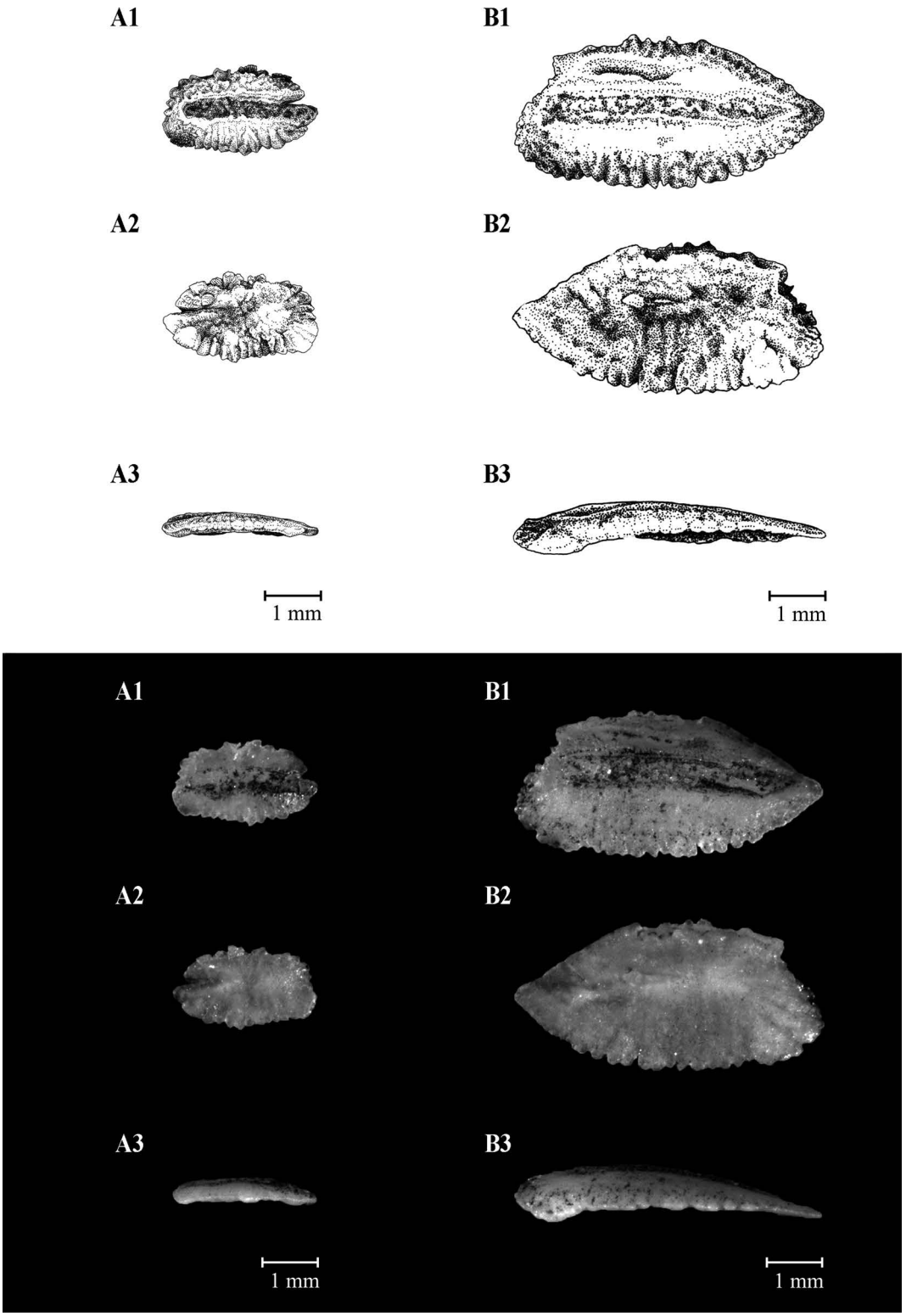


Plate 5. Illustrations (above) and photographs (below) of *Strongylura marina* otoliths from fish with total length: A. 283 mm; B. 621 mm. The medial face is shown in A1; B1; the lateral face in A2; B2; and the ventral profile in A3; B3 (Illustration: Michelle Konig; Photos: Cesar Santificetur).

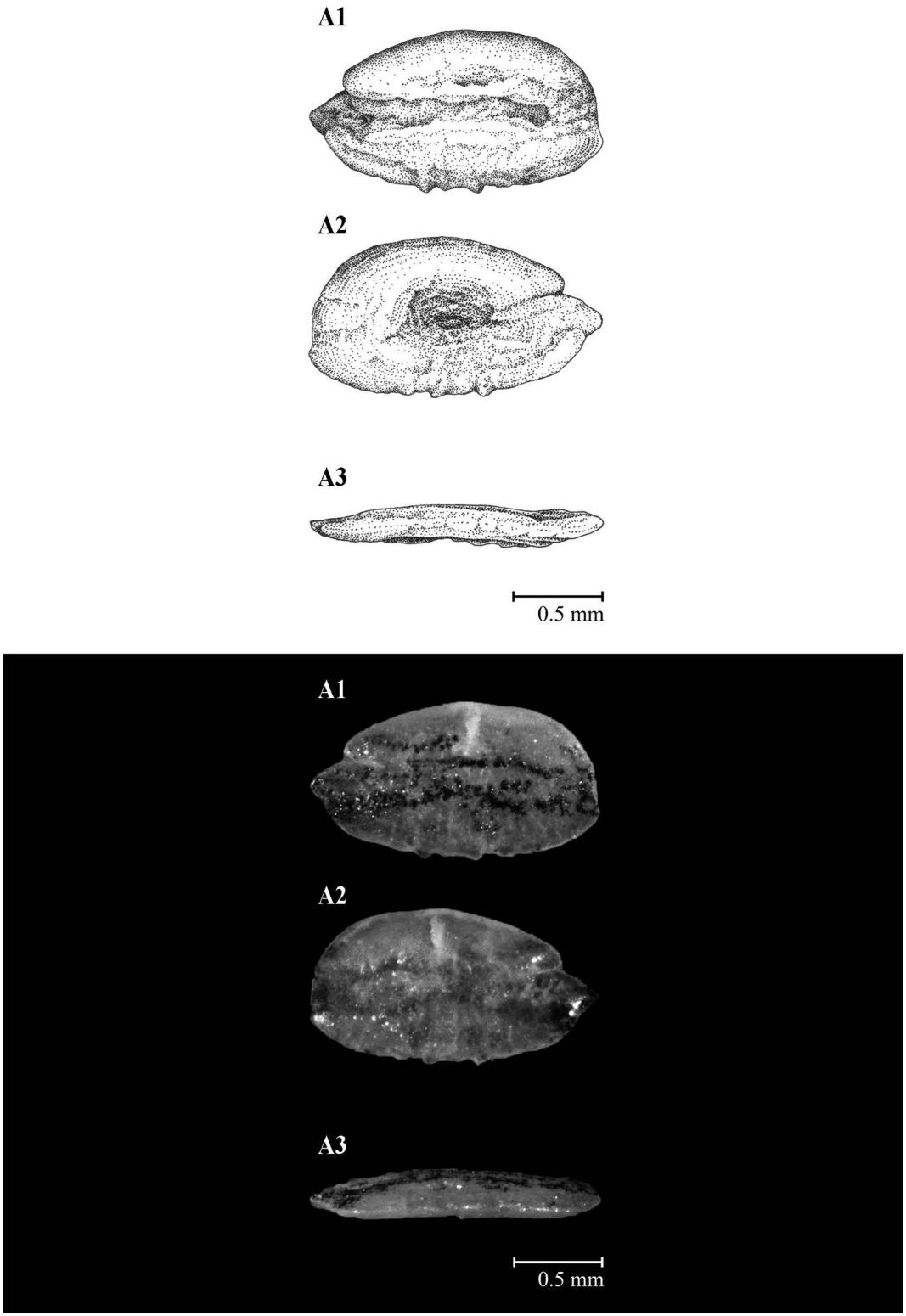


Plate 6. Illustrations (above) and photographs (below) of *Strongylura timucu* right otolith from fish with total length: A. 156 mm. The medial face is shown in A1; the lateral face in A2; and the ventral profile in A3 (Illustration: Michelle Konig; Photos: Cesar Santificetur).

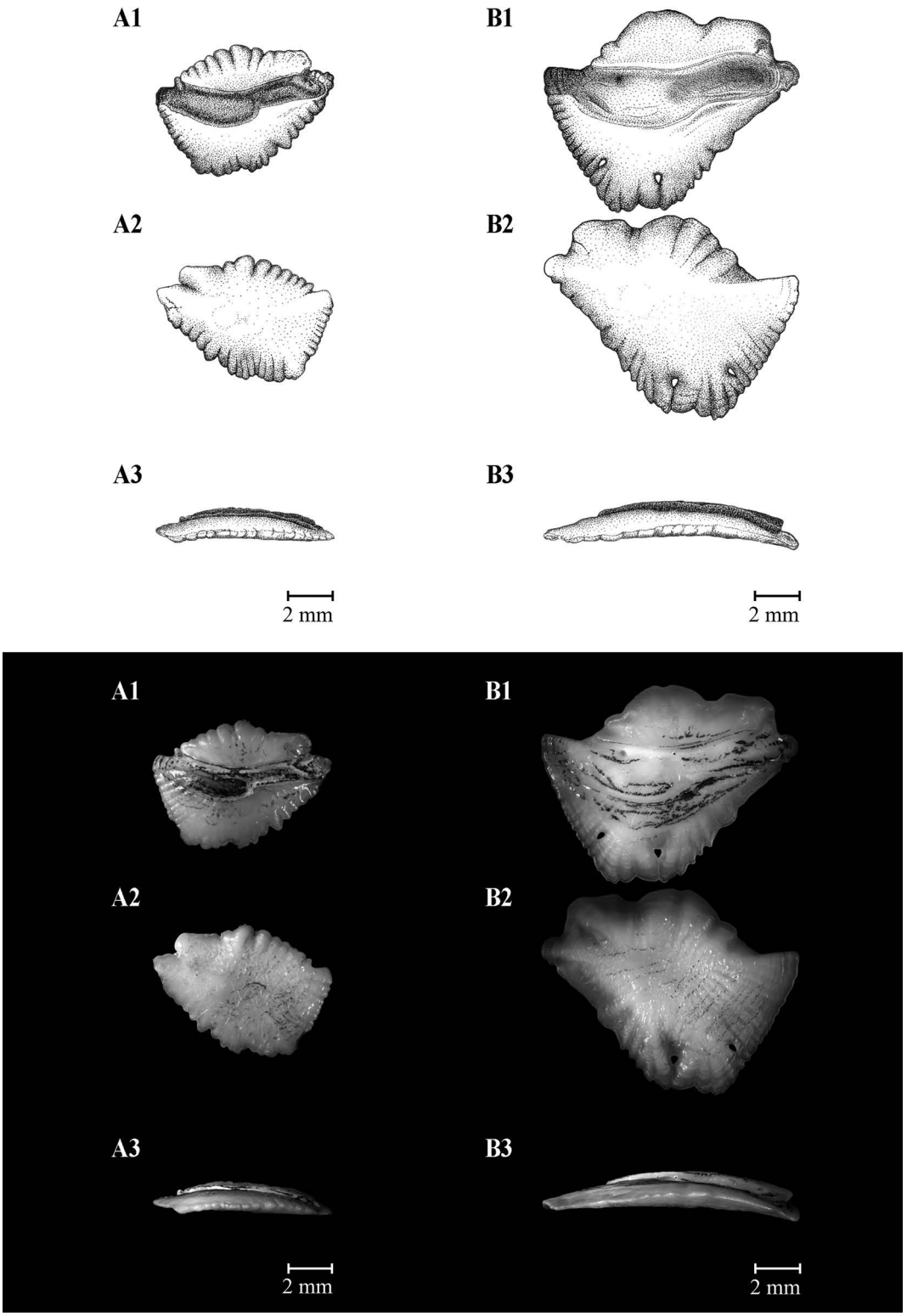


Plate 7. Illustrations (above) and photographs (below) of *Beryx splendens* right otoliths from fish with total length: A. 170 mm; B. 314 mm. The medial face is shown in A1; B1; the lateral face in A2; B2; and the ventral profile in A3; B3 (Illustration: Laura Montserrat; Photos: Cesar Santificetur).

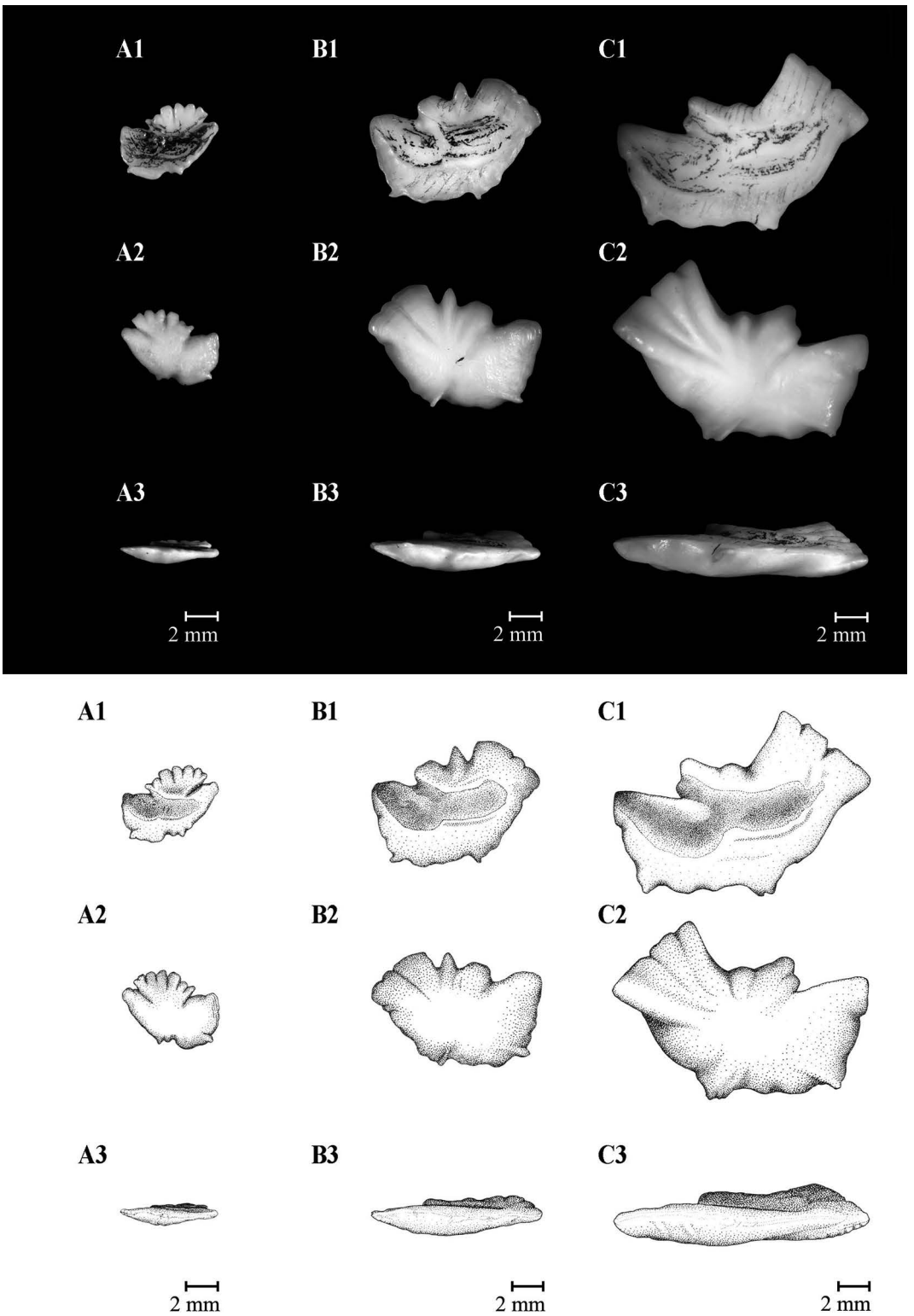


Plate 8. Illustrations (above) and photographs (below) of *Hoplostethus occidentalis* right otoliths from fish with total length: A. 93 mm; B. 169 mm; C. 245 mm. The medial face is shown in A1; B1; C1; the lateral face in A2; B2; C2; and the ventral profile in A3; B3; C3 (Illustration: Laura Montserrat; Photos: Cesar Santificetur).

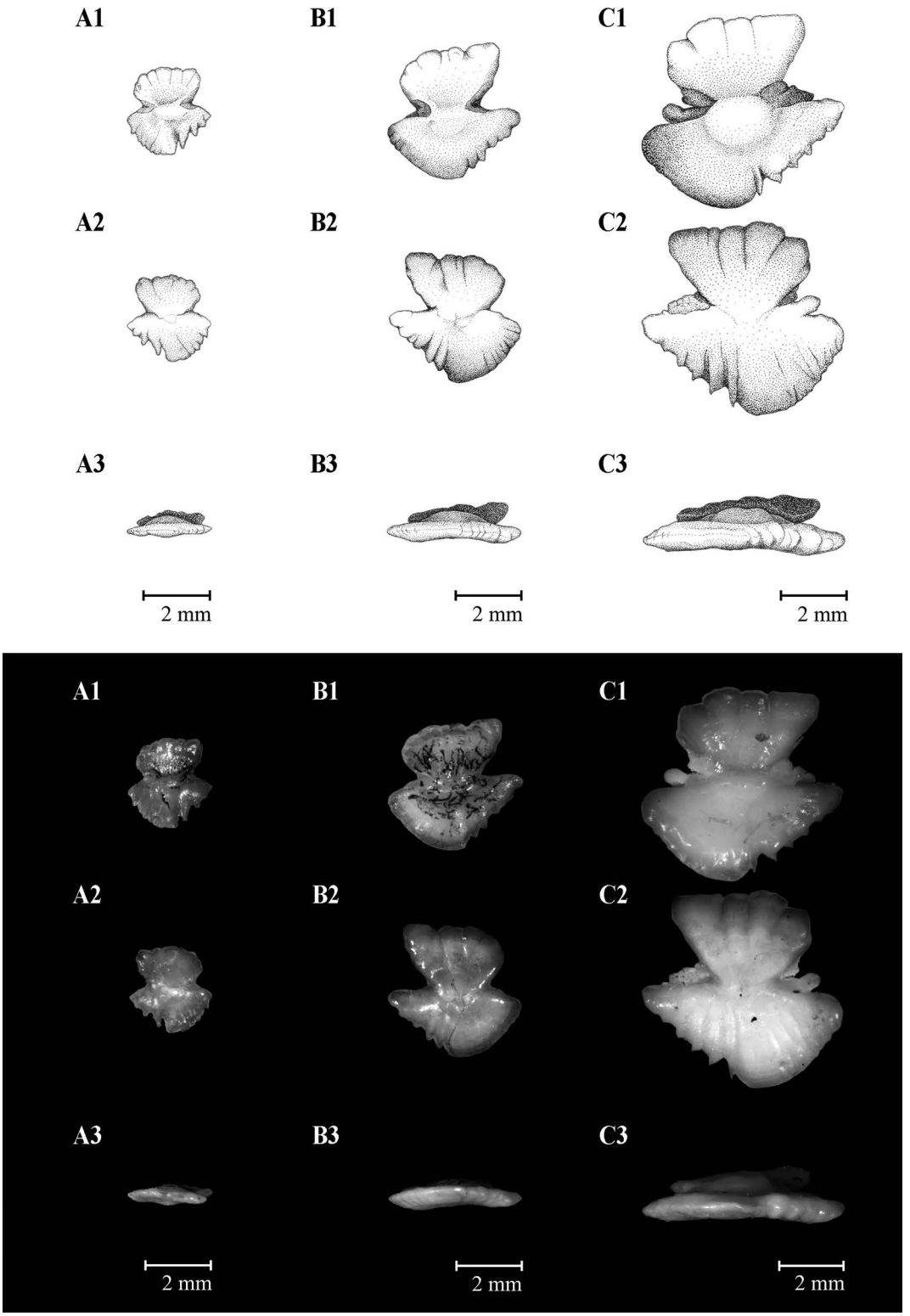


Plate 9. Illustrations (above) and photographs (below) of *Xenolepidichthys dalgleishi* otoliths from fish with total length: A. 68 mm; B. 127 mm; C. 260 mm. The medial face is shown in A1; B1; C1; the lateral face in A2; B2; C2; and the ventral profile in A3; B3; C3 (Illustration: Laura Montserrat; Photos: Cesar Santificetur).

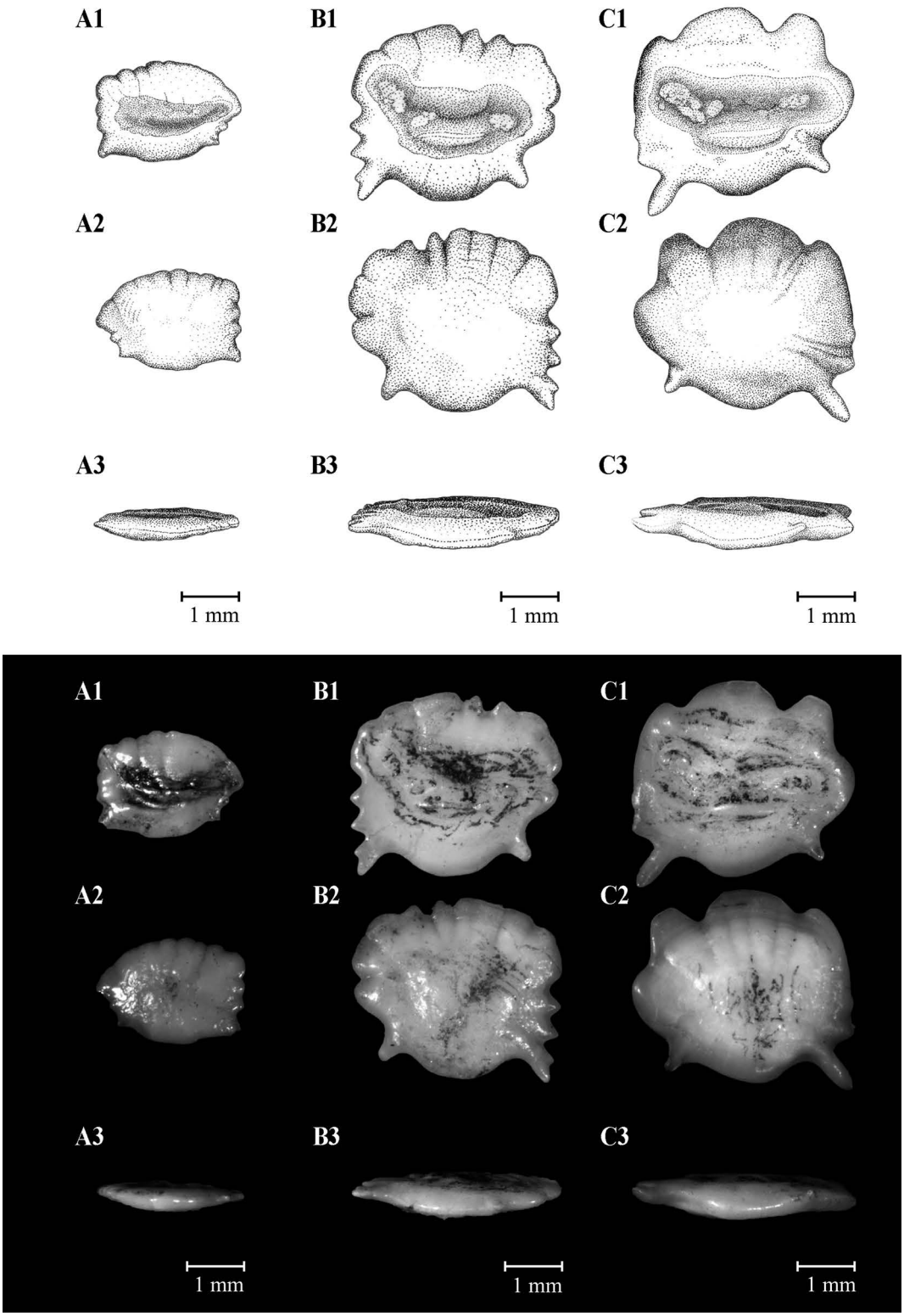


Plate 10. Illustrations (above) and photographs (below) of *Zenion hololepis* otoliths from fish with total length: A. 56 mm; B. 114 mm; C. 173 mm. The medial face is shown in A1; B1; C1; the lateral face in A2; B2; C2; and the ventral profile in A3; B3; C3 (Illustration: Laura Montserrat; Photos: Cesar Santificetur).

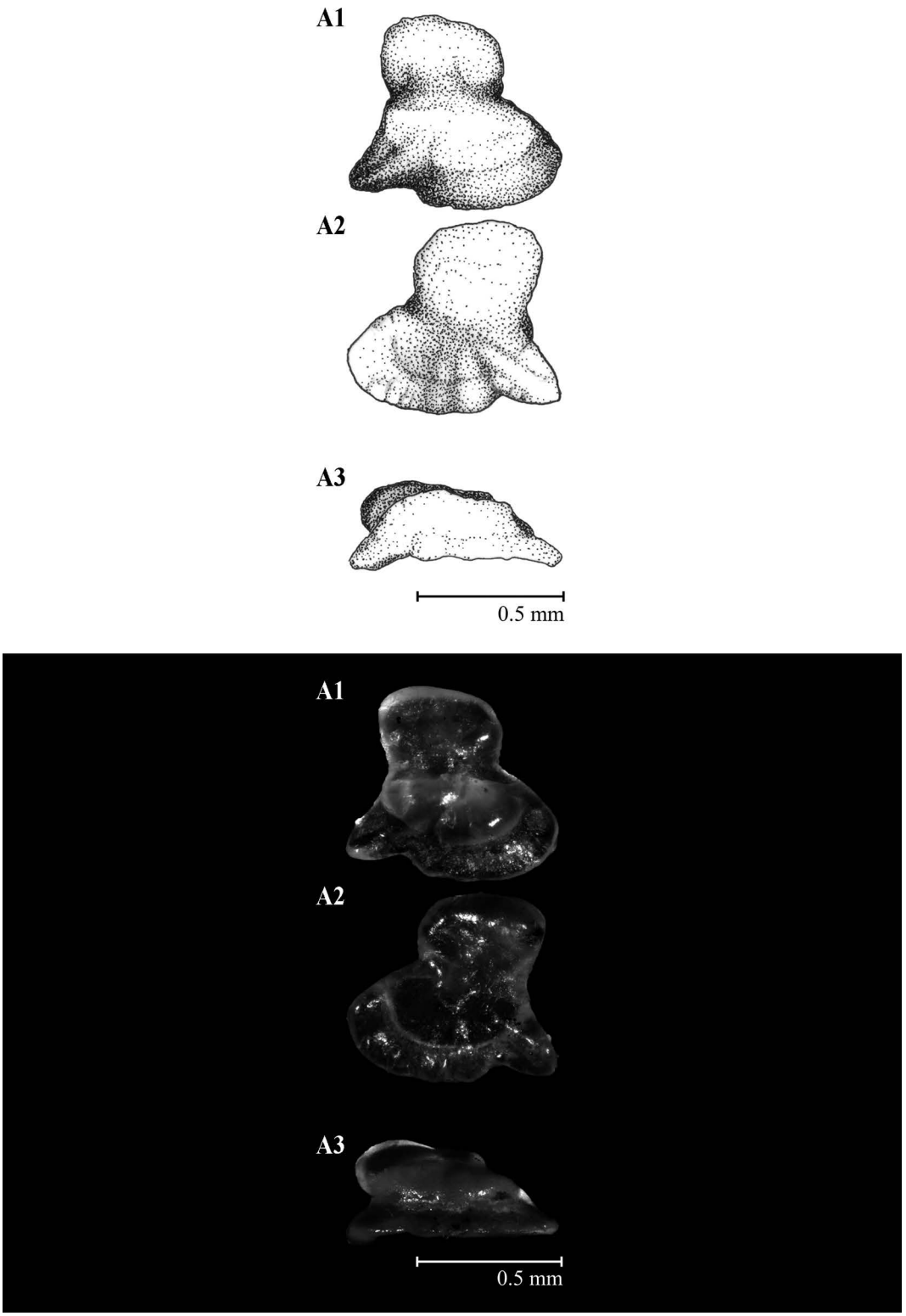


Plate 11. Illustrations (above) and photographs (below) of *Macroramphosus scolopax* otolith from fish with total length: A. 107 mm. The medial face is shown in A1; the lateral face in A2; and the ventral profile in A3 (Illustration: Alexandre Arackawa; Photos: Cesar Santificetur).

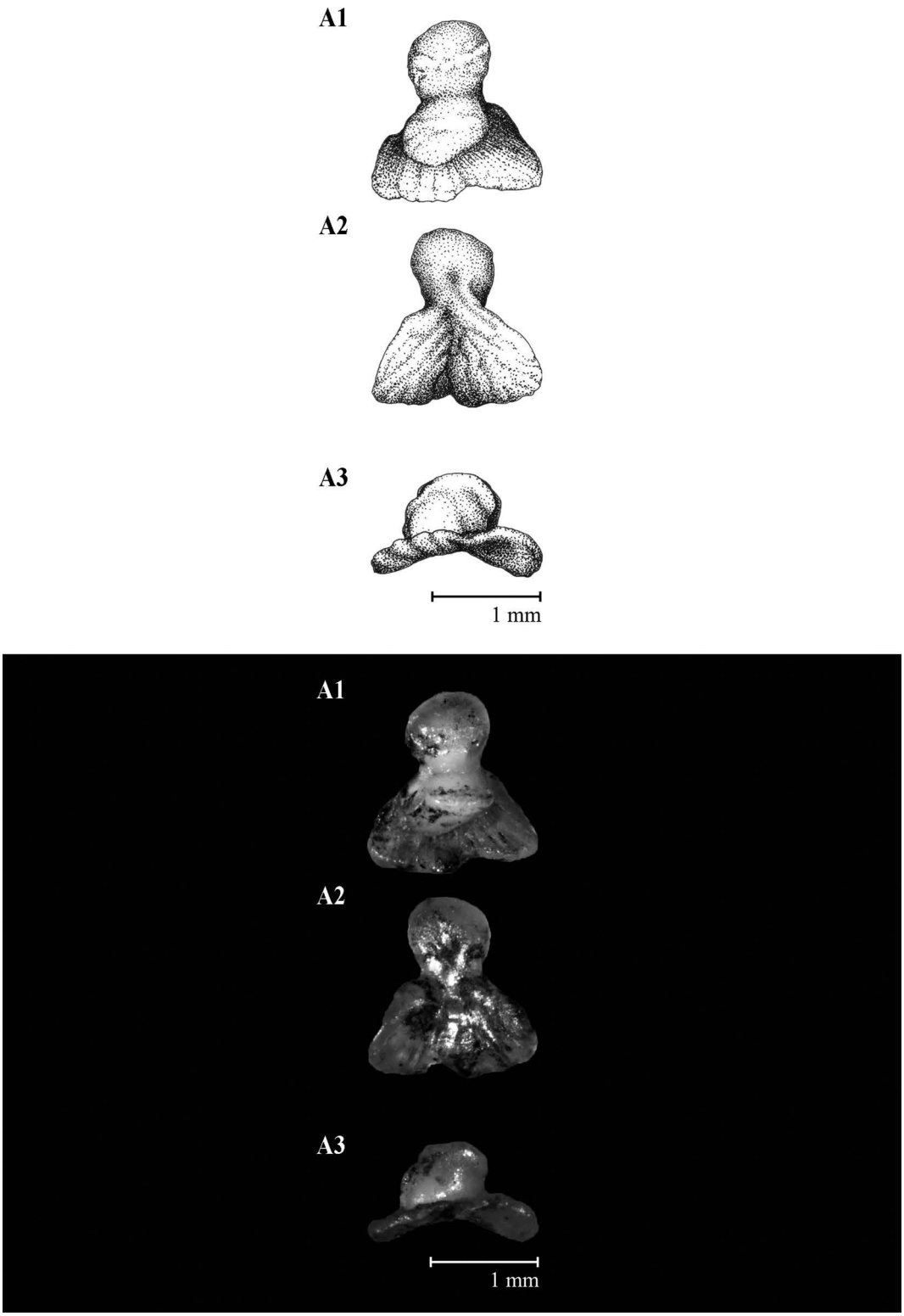


Plate 12. Illustrations (above) and photographs (below) of *Notopogon fernandezianus* otolith from fish with total length: A. 161 mm. The medial face is shown in A1; the lateral face in A2; and the ventral profile in A3 (Illustration: Alexandre Arackawa; Photos: Cesar Santificetur).

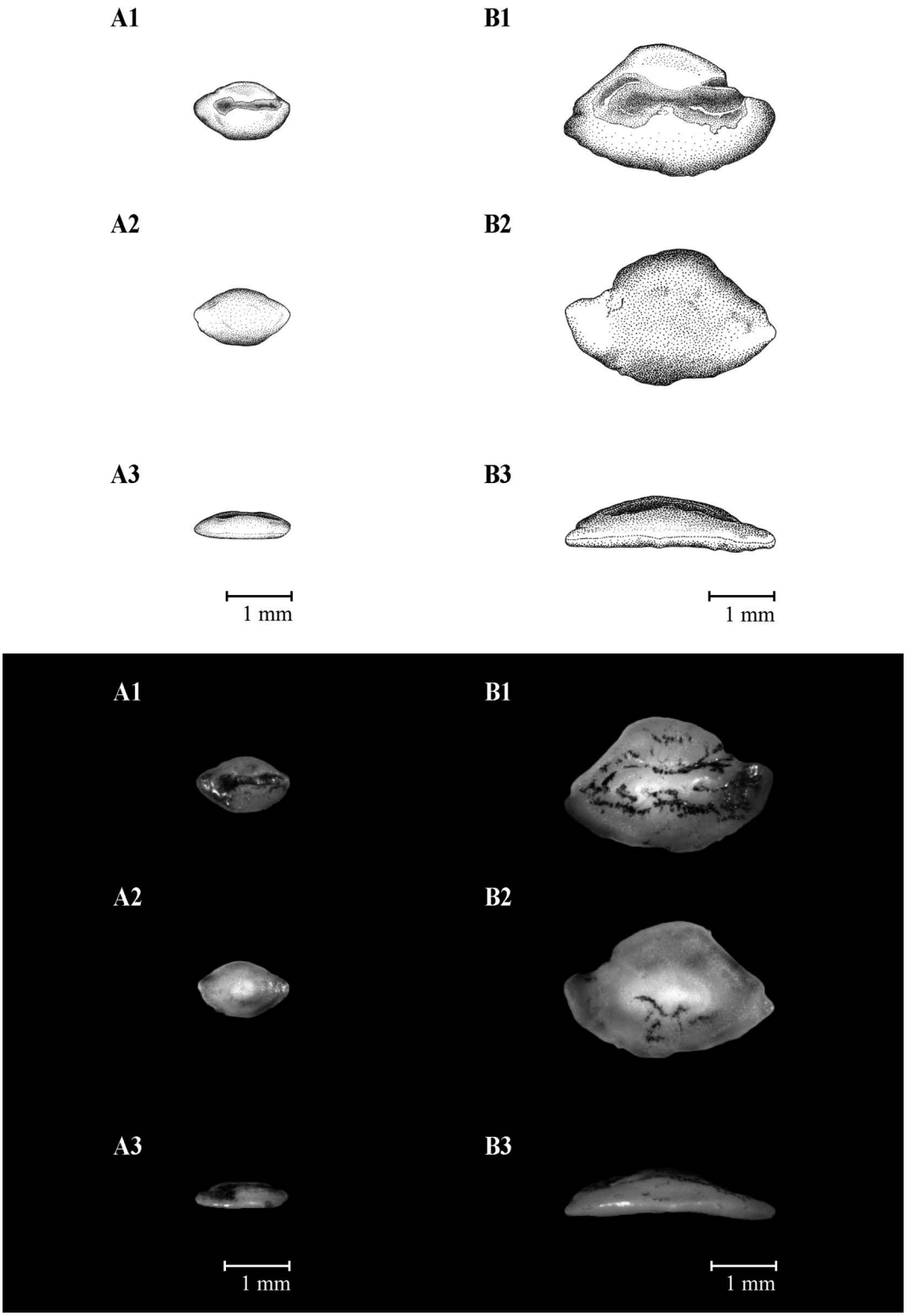


Plate 13. Illustrations (above) and photographs (below) of *Bellator brachychir* otoliths from fish with total length: A. 34 mm; B. 95 mm. The medial face is shown in A1; B1; the lateral face in A2; B2; and the ventral profile in A3; B3 (Illustration: Laura Montserrat; Photos: Cesar Santificetur).

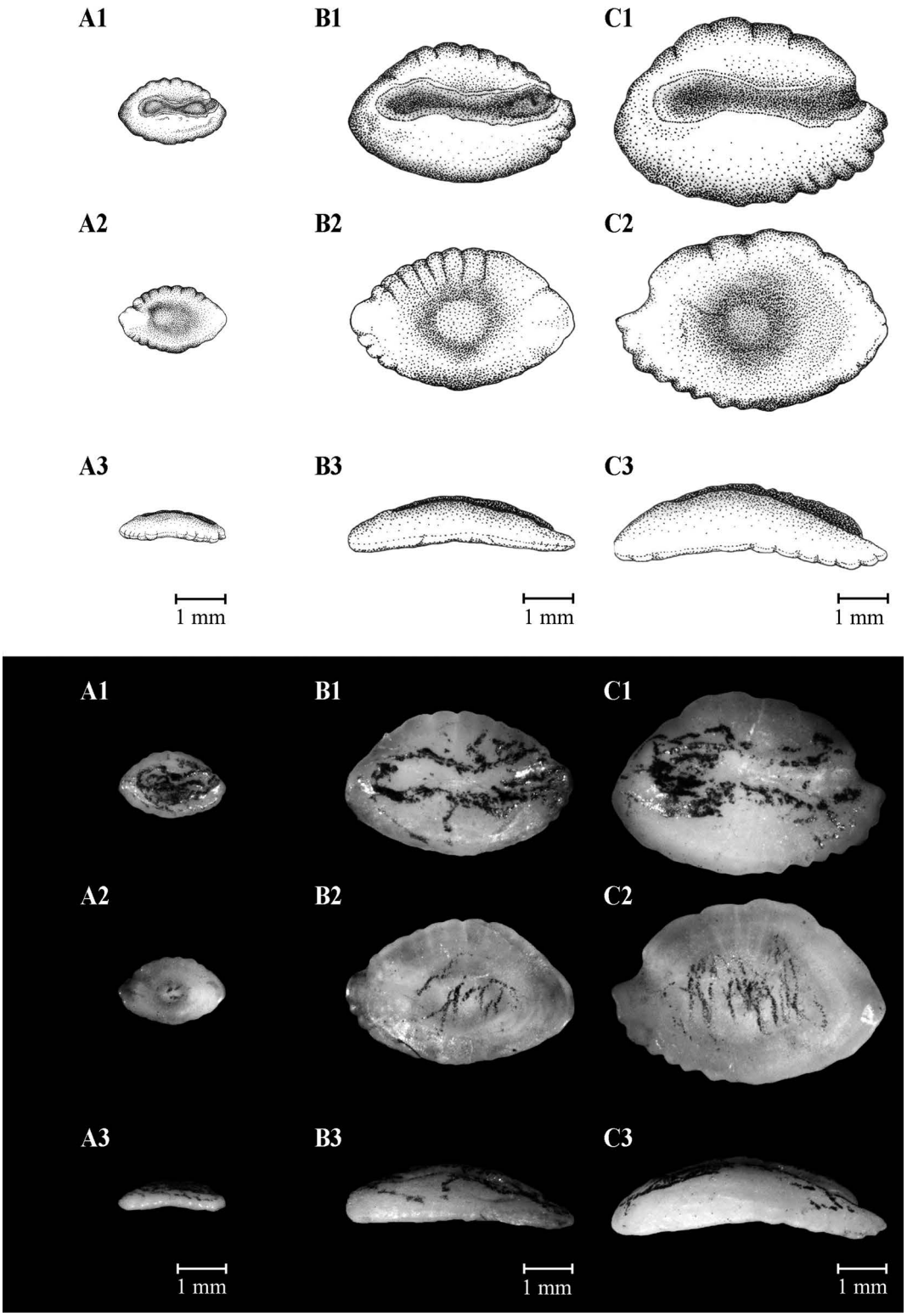


Plate 14. Illustrations (above) and photographs (below) of *Prionotus nudigula* otoliths from fish with total lengths: A. 68 mm; B. 162 mm; C. 265 mm. The medial face is shown in A1, B1, C1; the lateral face in A2, B2, C2; and the ventral profile in A3, B3, C3 (Illustration: Laura Montserrat; Photos: Cesar Santificetur).

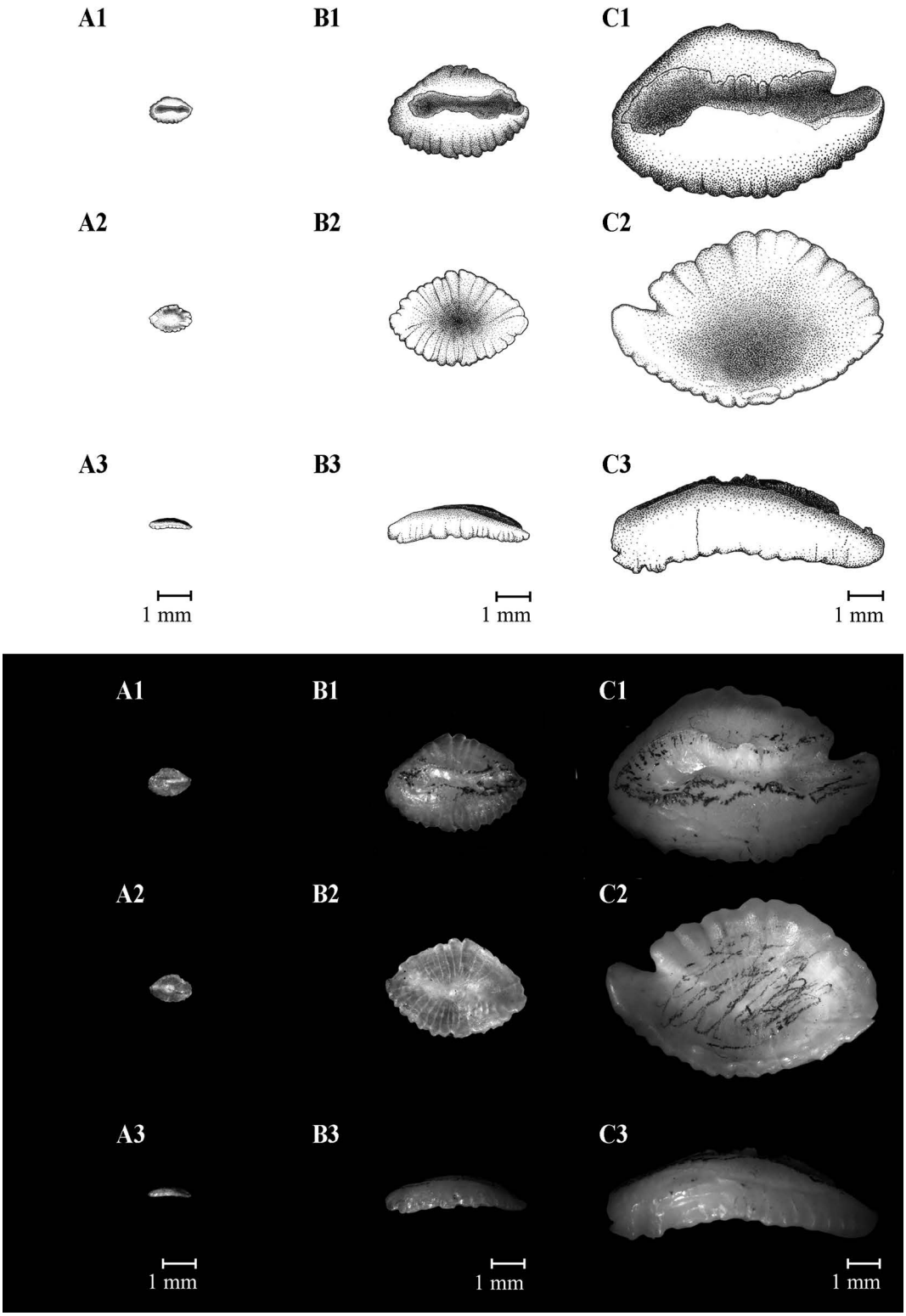


Plate 15. Illustrations (above) and photographs (below) of *Prionotus punctatus* otoliths from fish with total lengths: A. 36 mm; B. 184 mm; C. 391 mm. The medial face is shown in A1, B1, C1; the lateral face in A2, B2, C2; and the ventral profile in A3, B3, C3 (Illustration: Laura Montserrat; Photos: Cesar Santificetur).

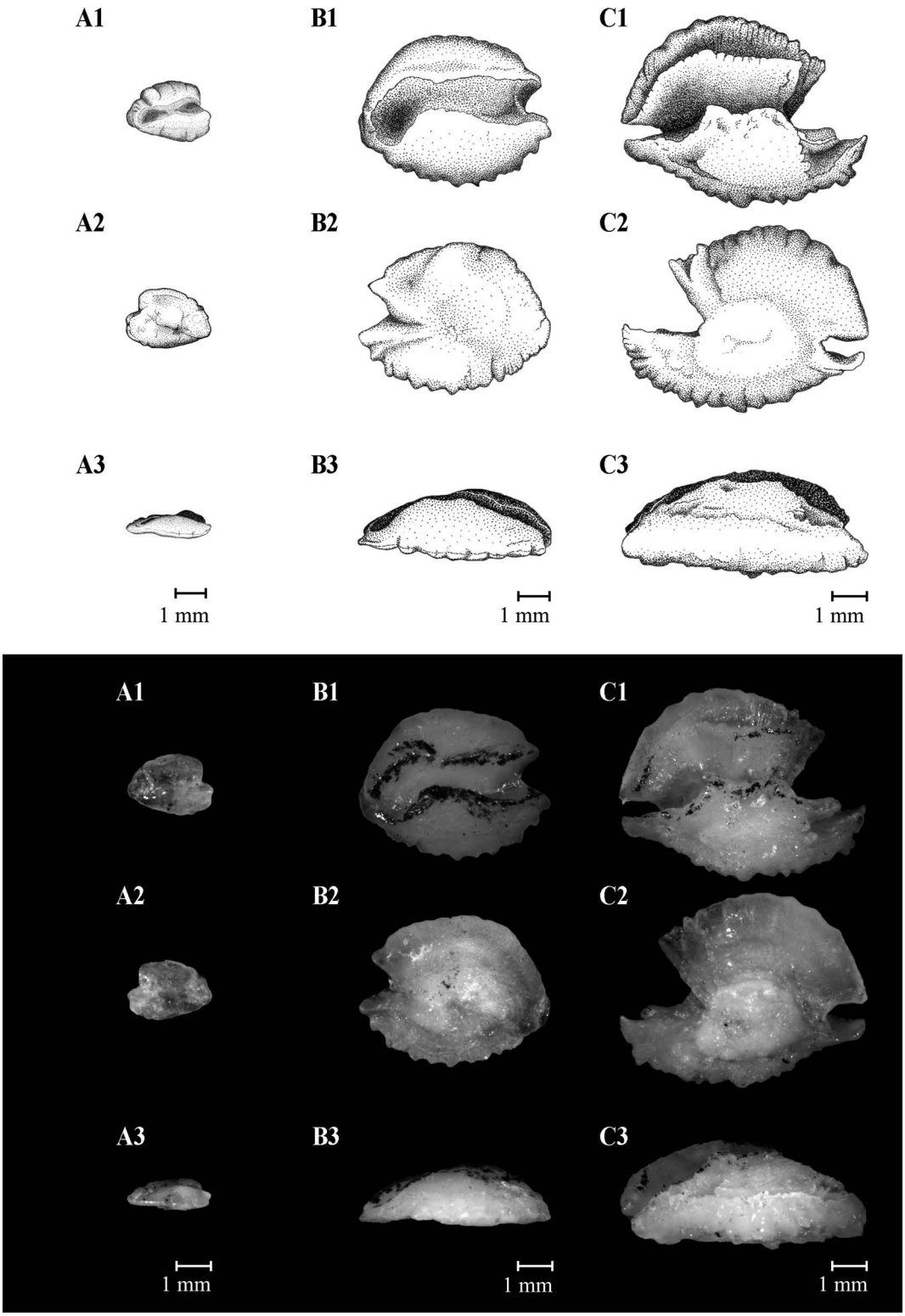


Plate 16. Illustrations (above) and photographs (below) of *Dactylopterus volitans* otoliths from fish with total lengths: A. 65 mm; B. 192 mm; C. 272 mm. The medial face is shown in A1, B1, C1; the lateral face in A2, B2, C2; and the ventral profile in A3, B3, C3 (Illustration: Laura Montserrat; Photos: Cesar Santificetur).

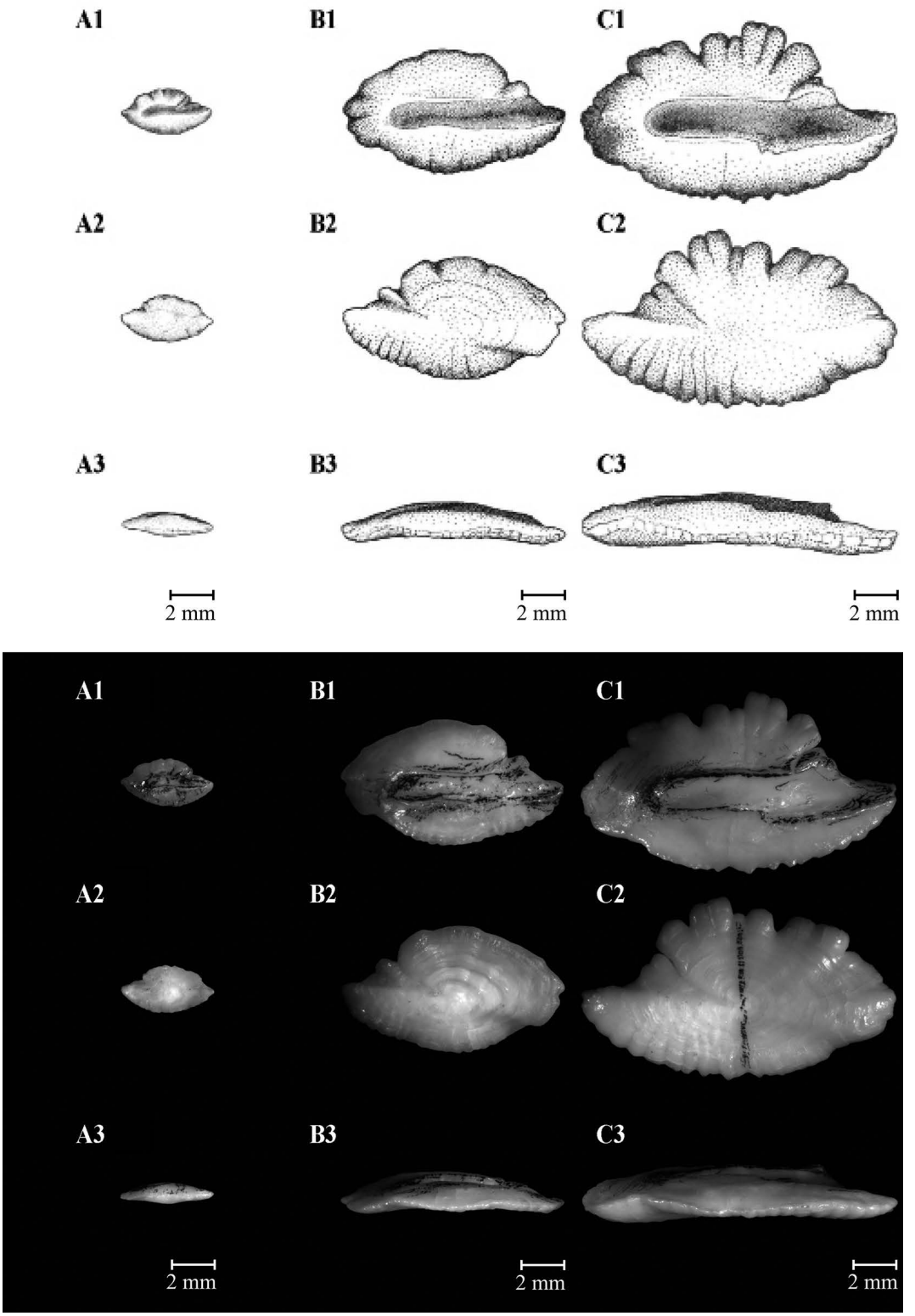


Plate 17. Illustrations (above) and photographs (below) of *Helicolenus lahillei* otoliths from fish with total lengths: A. 75 mm; B. 260 mm; C. 462 mm. The medial face is shown in A1, B1, C1; the lateral face in A2, B2, C2; and the ventral profile in A3, B3, C3 (Illustration: Laura Montserrat; Photos: Cesar Santificetur).

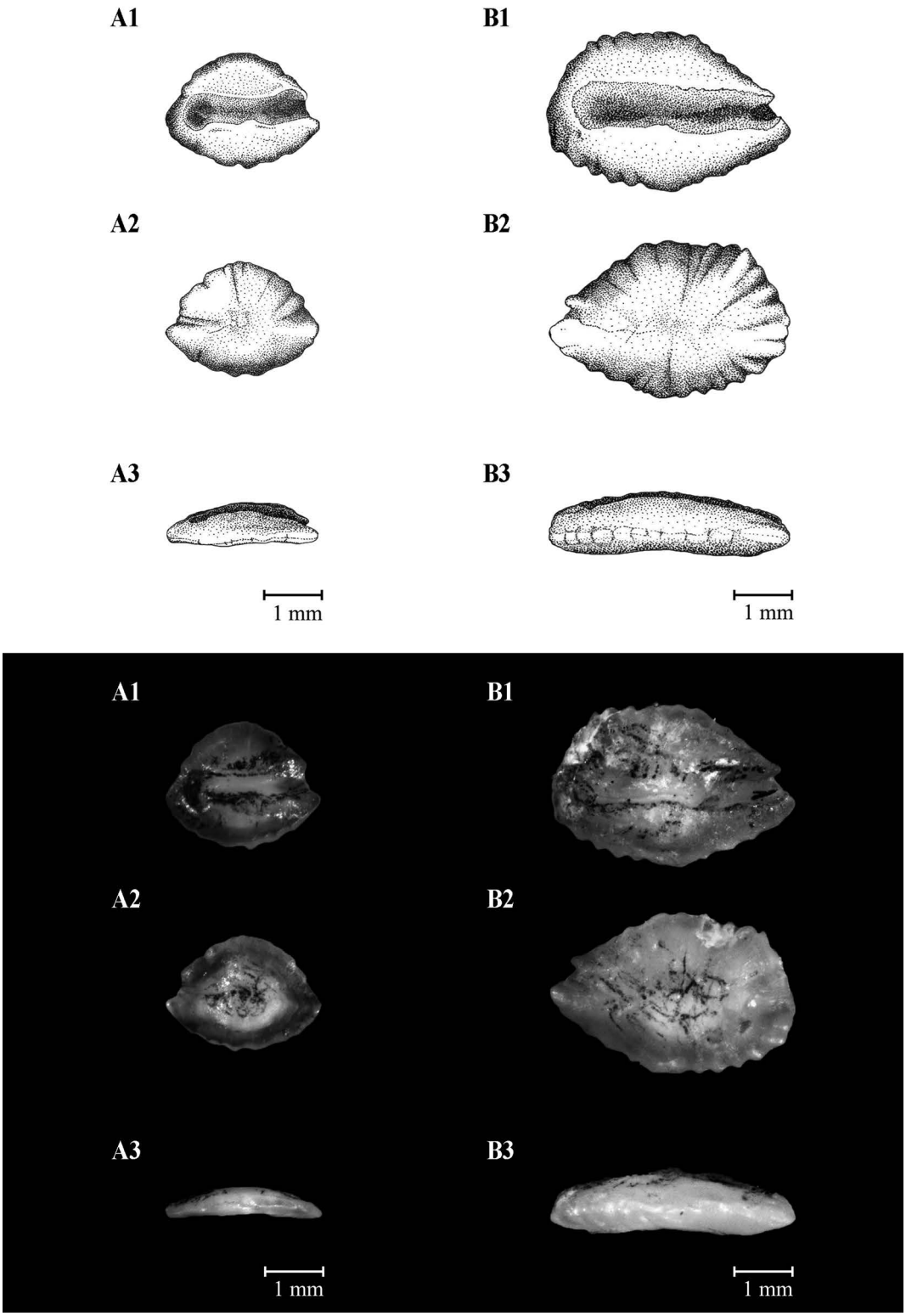


Plate 18. Illustrations (above) and photographs (below) of *Peristedion altipinne* otolith from fish with total lengths: A. 124 mm; B. 258 mm. The medial face is shown in A1, B1; the lateral face in A2, B2; and the ventral profile in A3, B3 (Illustration: Laura Montserrat; Photos: Cesar Santificetur).

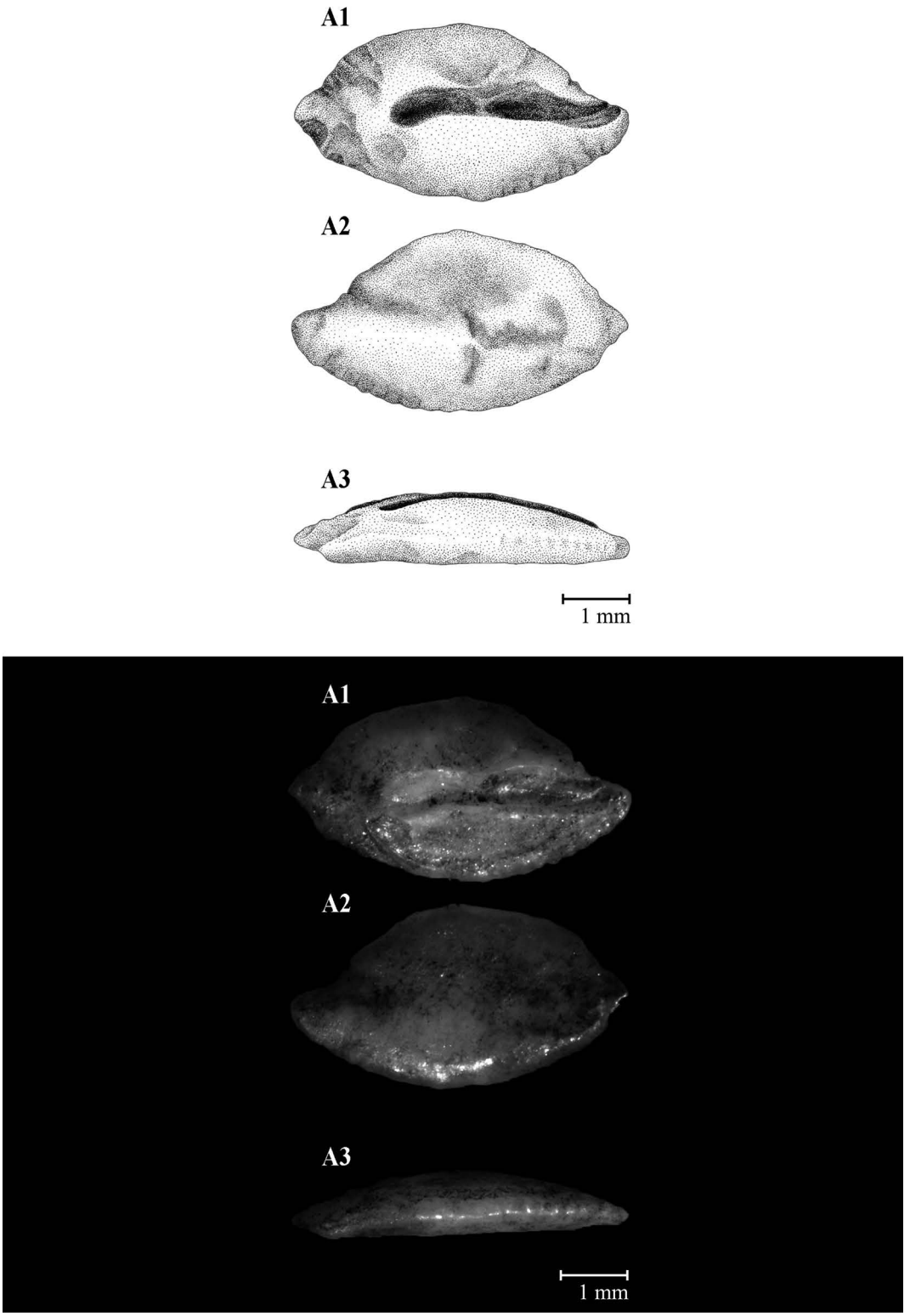


Plate 19. Illustrations (above) and photographs (below) of *Pontinus rathbuni* otolith from fish with total length: A. 97 mm. The medial face is shown in A1; the lateral face in A2; and the ventral profile in A3 (Illustration: Vanessa Sugihara; Photos: Cesar Santificetur).

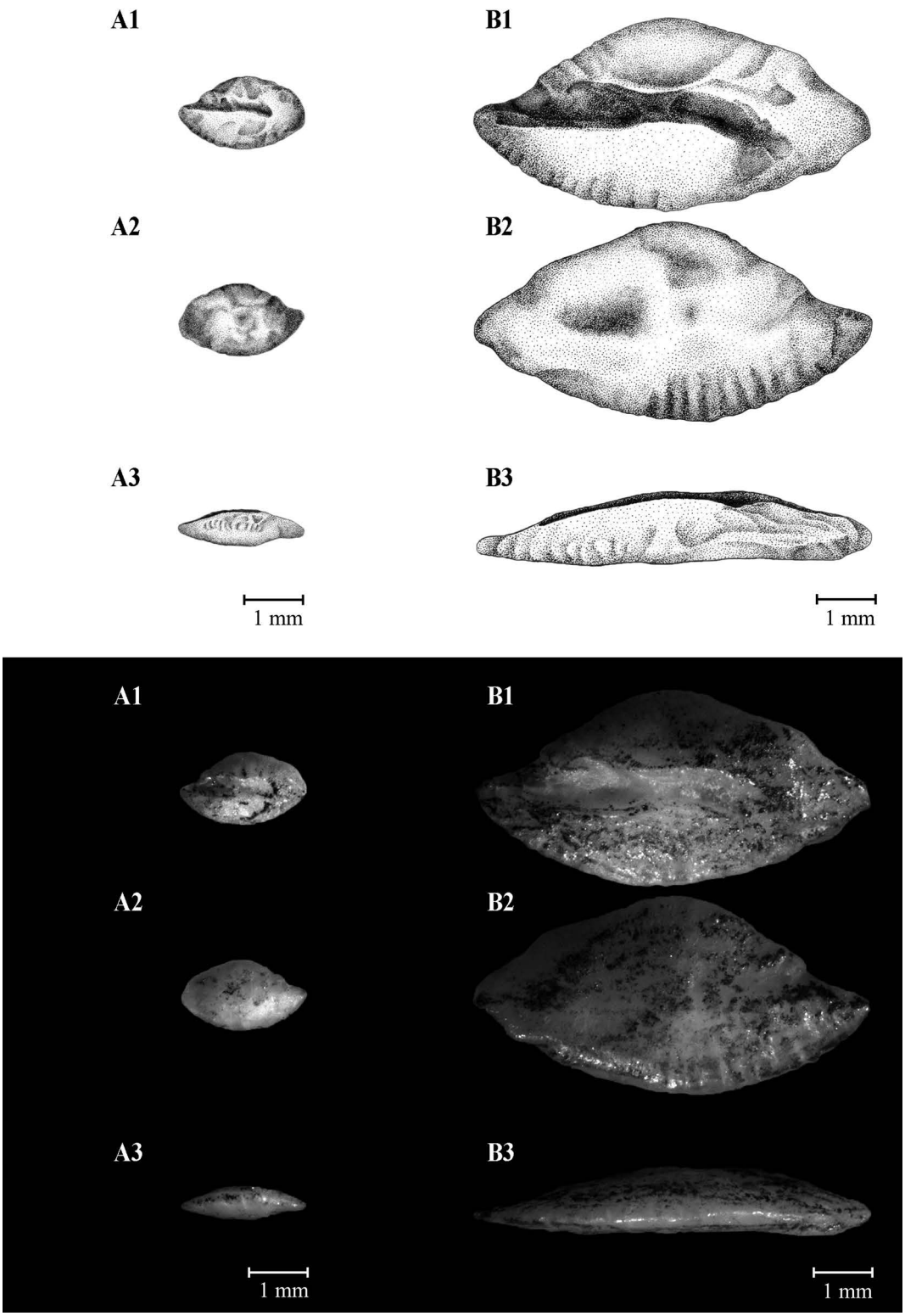


Plate 20. Illustrations (above) and photographs (below) of *Scorpaena dispar* right otoliths from fish with total lengths: A. 38 mm; B. 129 mm. The medial face is shown in A1, B1; the lateral face in A2, B2; and the ventral profile in A3, B3 (Illustration: Vanessa Sugihara; Photos: Cesar Santificetur).

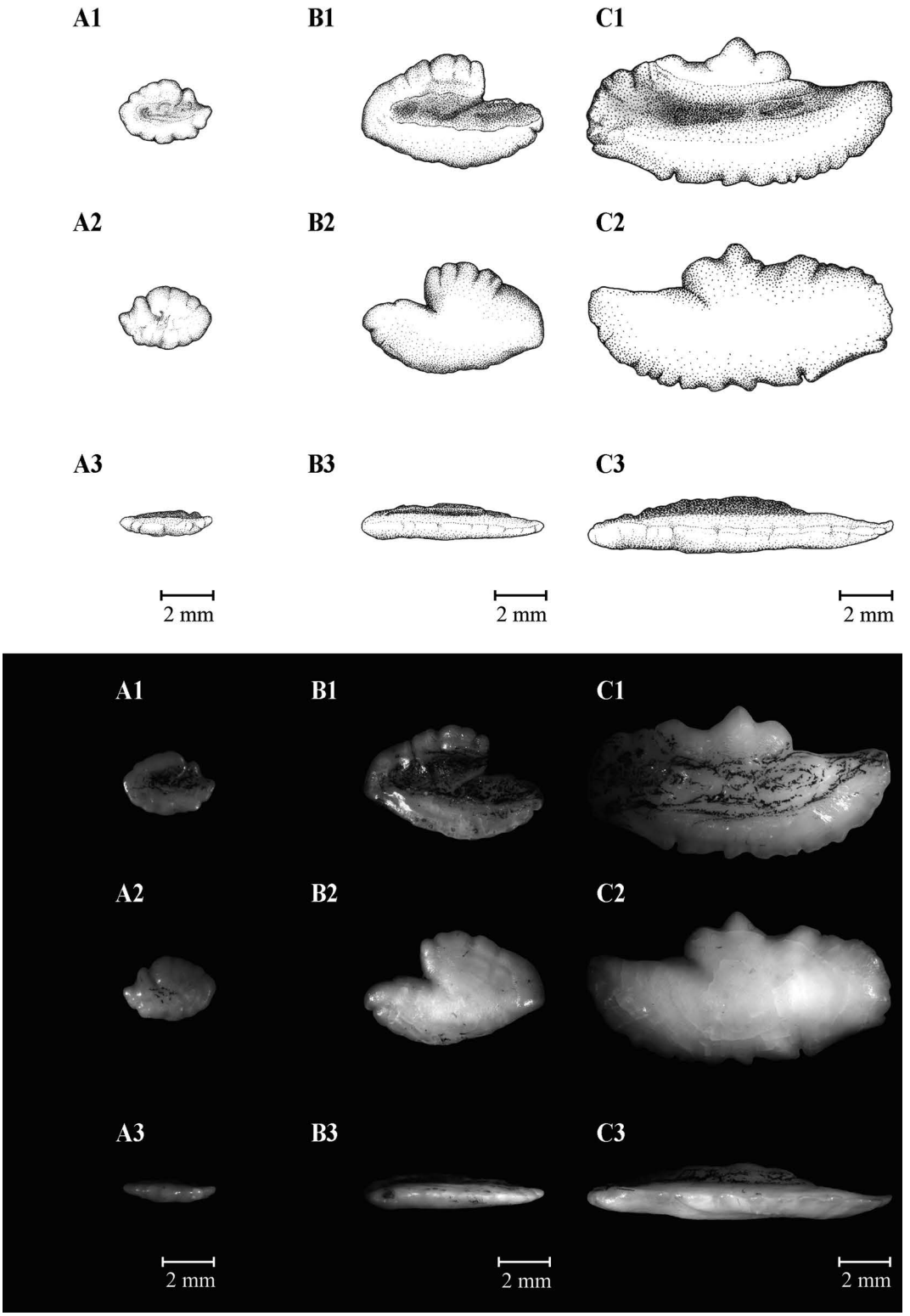
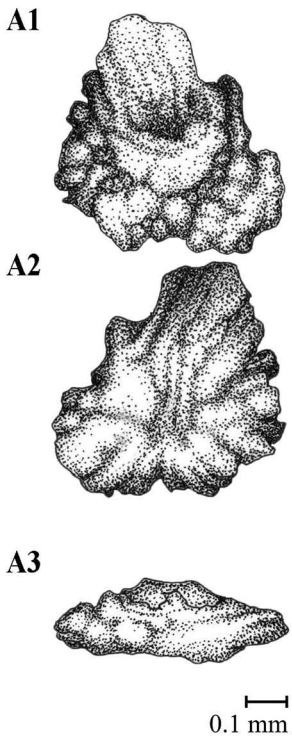


Plate 21. Illustrations (above) and photographs (below) of *Setarches guentheri* otoliths from fish with total lengths: A. 43 mm; B. 148 mm; C. 254 mm. The medial face is shown in A1, B1, C1; the lateral face in A2, B2, C2; and the ventral profile in A3, B3, C3 (Illustration: Laura Montserrat; Photos: Cesar Santificetur).



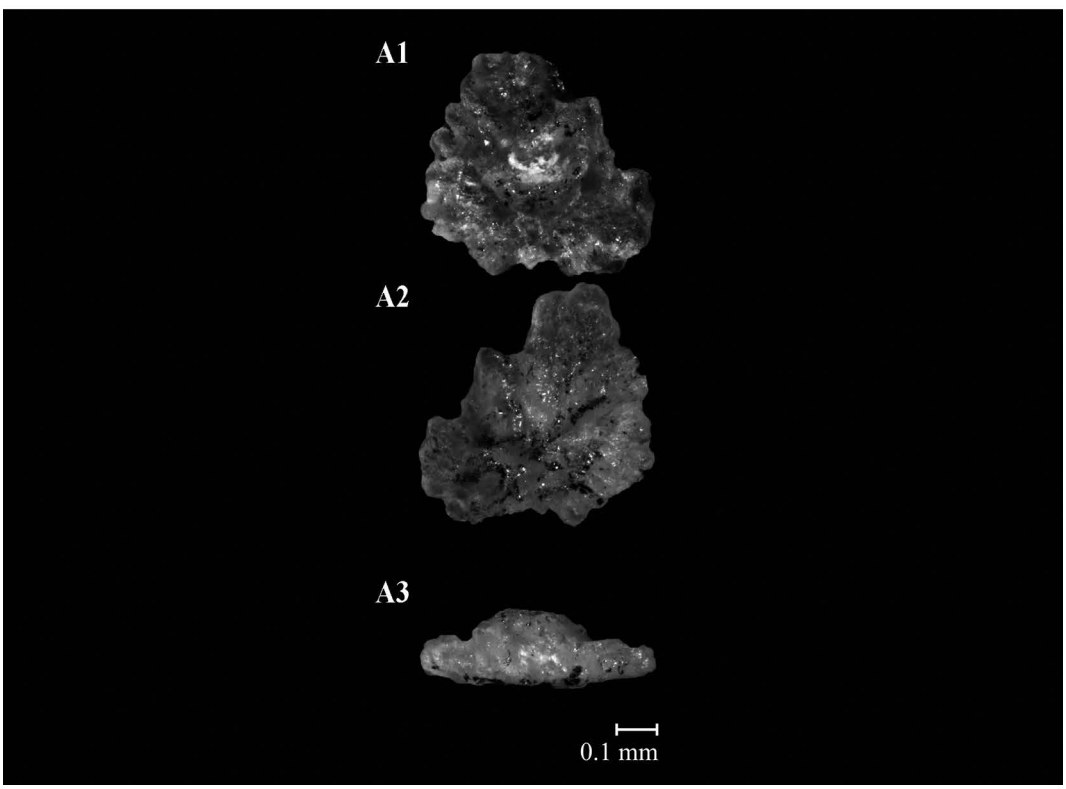


Plate 22. Illustrations (above) and photographs (below) of *Chilomycterus spinosus* otolith from fish with total length: A. 52 mm. The medial face is shown in A1; the lateral face in A2; and the ventral profile in A3 (Illustration: Alexandre Arackawa; Photos: Cesar Santificetur).

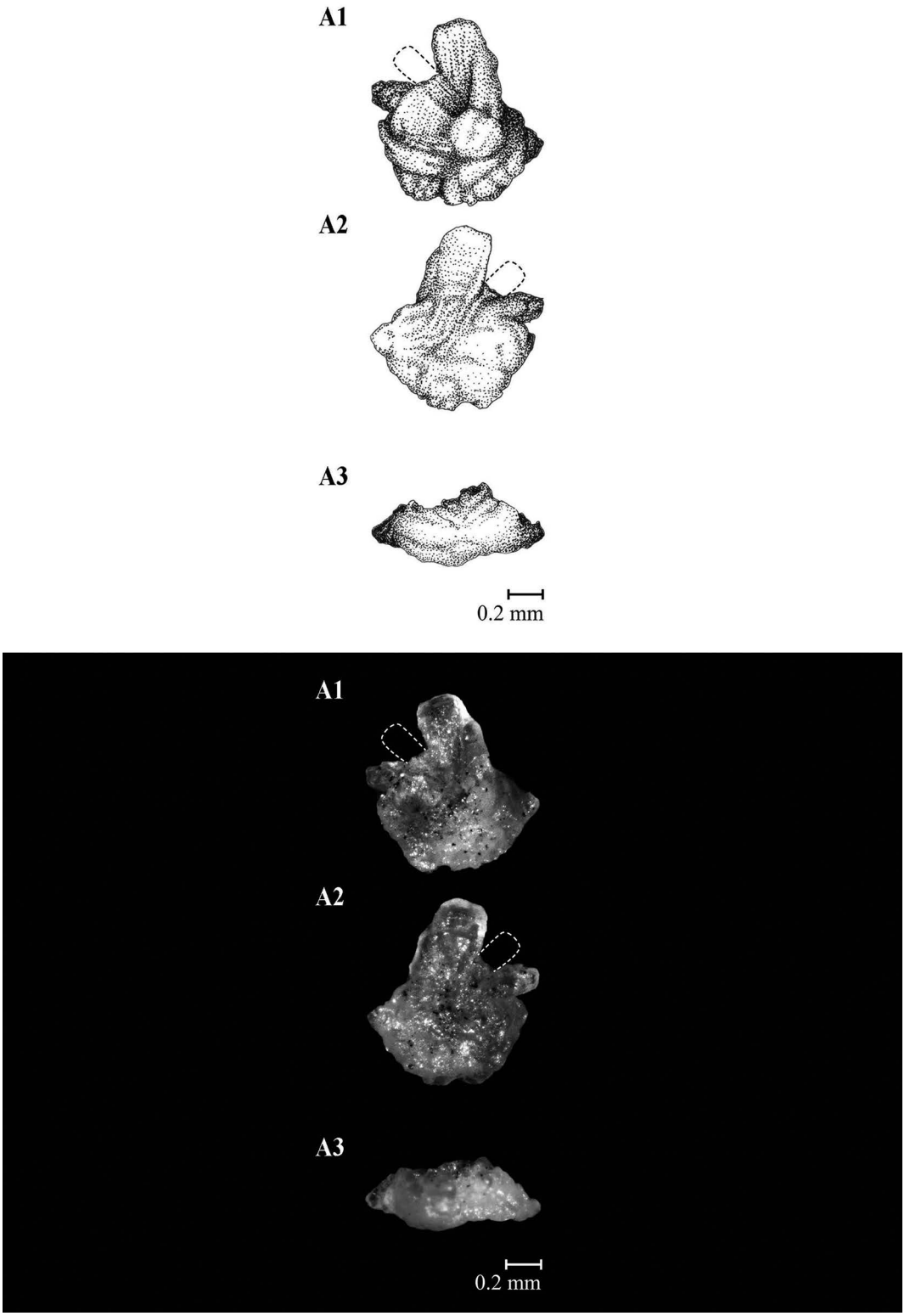


Plate 23. Illustrations (above) and photographs (below) of *Diodon holocanthus* otolith from fish with total length: A. 111 mm. The medial face is shown in A1; the lateral face in A2; and the ventral profile in A3 (Illustration: Alexandre Arackawa; Photos: Cesar Santificetur).

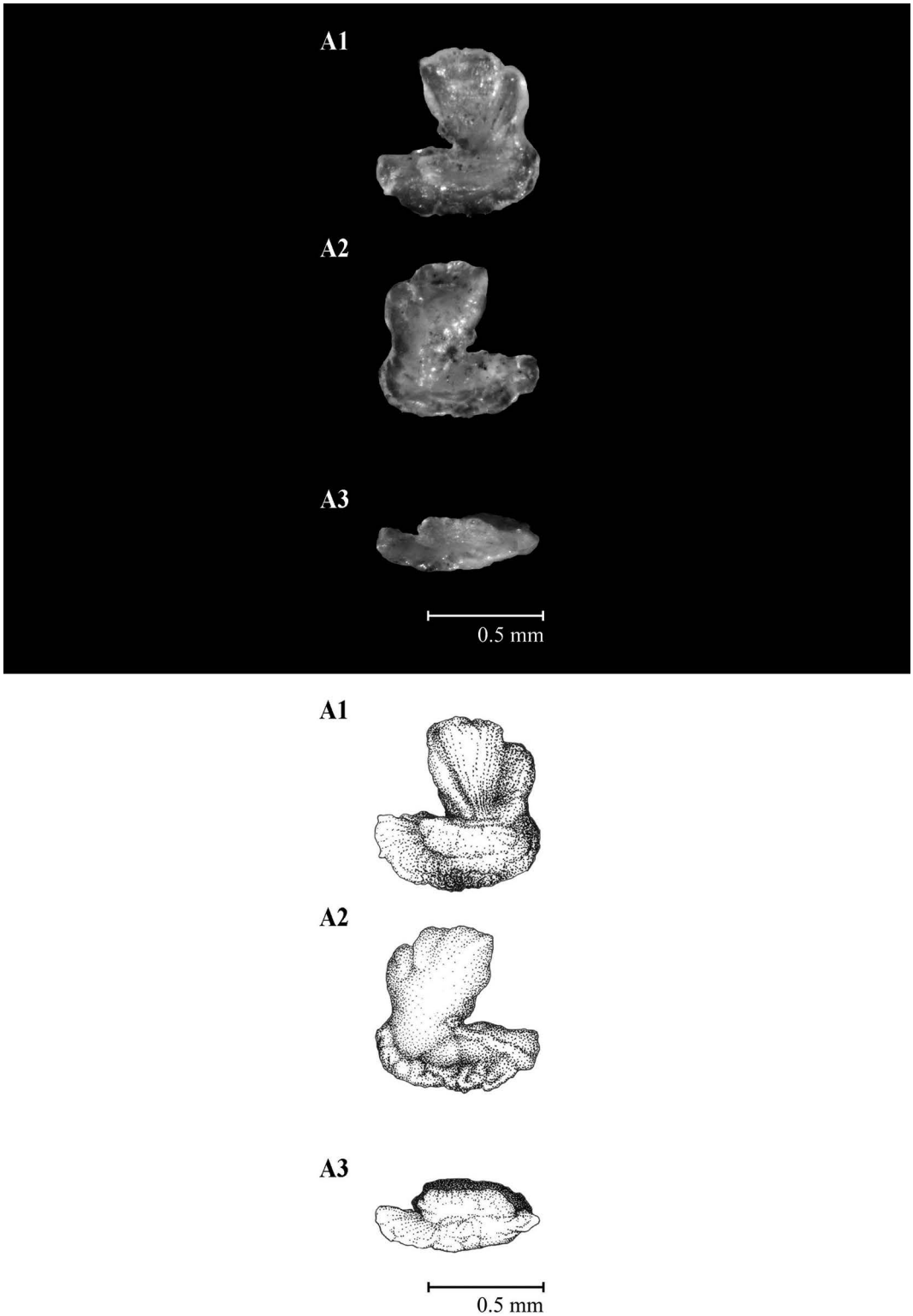


Plate 24. Illustrations (above) and photographs (below) of *Lagocephalus laevigatus* right otolith from fish with total length: A. 144 mm. The medial face is shown in A1; the lateral face in A2; and the ventral profile in A3 (Illustration: Alexandre Arackawa; Photos: Cesar Santificetur).

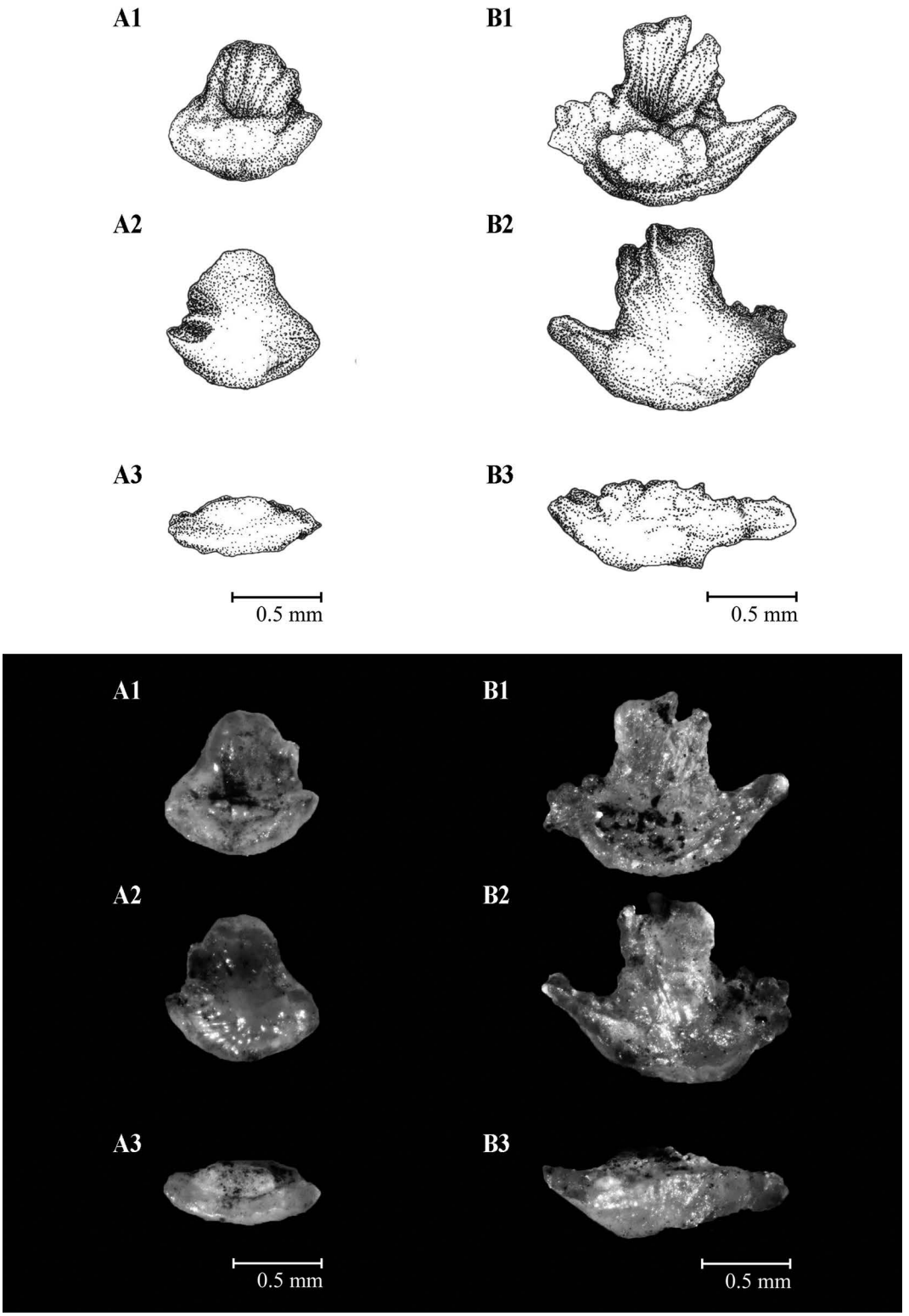


Plate 25. Illustrations (above) and photographs (below) of *Sphoeroides greeleyi* otoliths from fish with total lengths: A. 78 mm; B. 145 mm. The medial face is shown in A1, B1; the lateral face in A2, B2; and the ventral profile in A3, B3 (Illustration: Alexandre Arackawa; Photos: Cesar Santificetur).

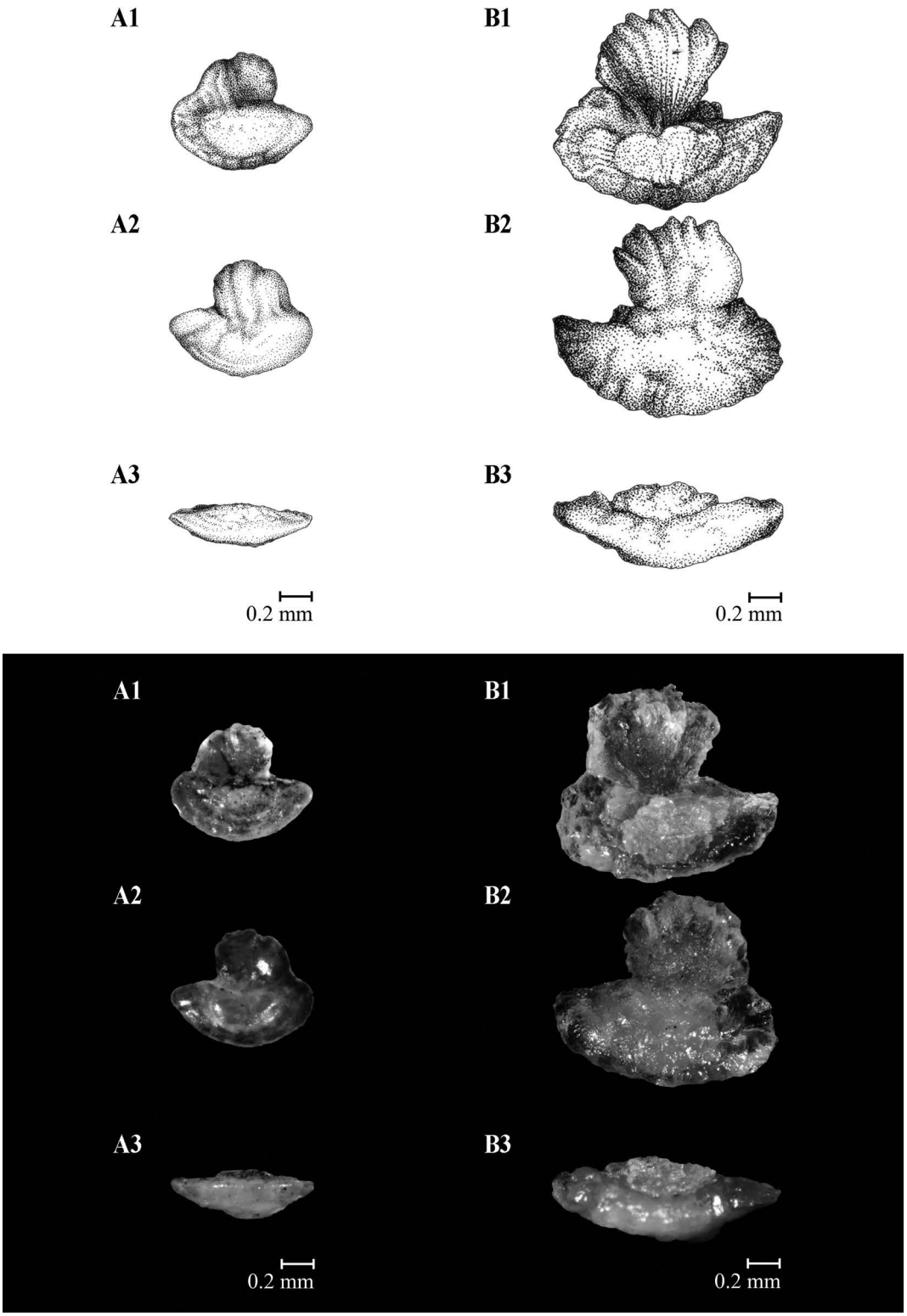


Plate 26. Illustrations (above) and photographs (below) of *Sphoeroides testudineus* otoliths from fish with total lengths: A. 94 mm; B. 212 mm. The medial face is shown in A1, B1; the lateral face in A2, B2; and the ventral profile in A3, B3 (Illustration: Alexandre Arackawa; Photos: Cesar Santificetur).

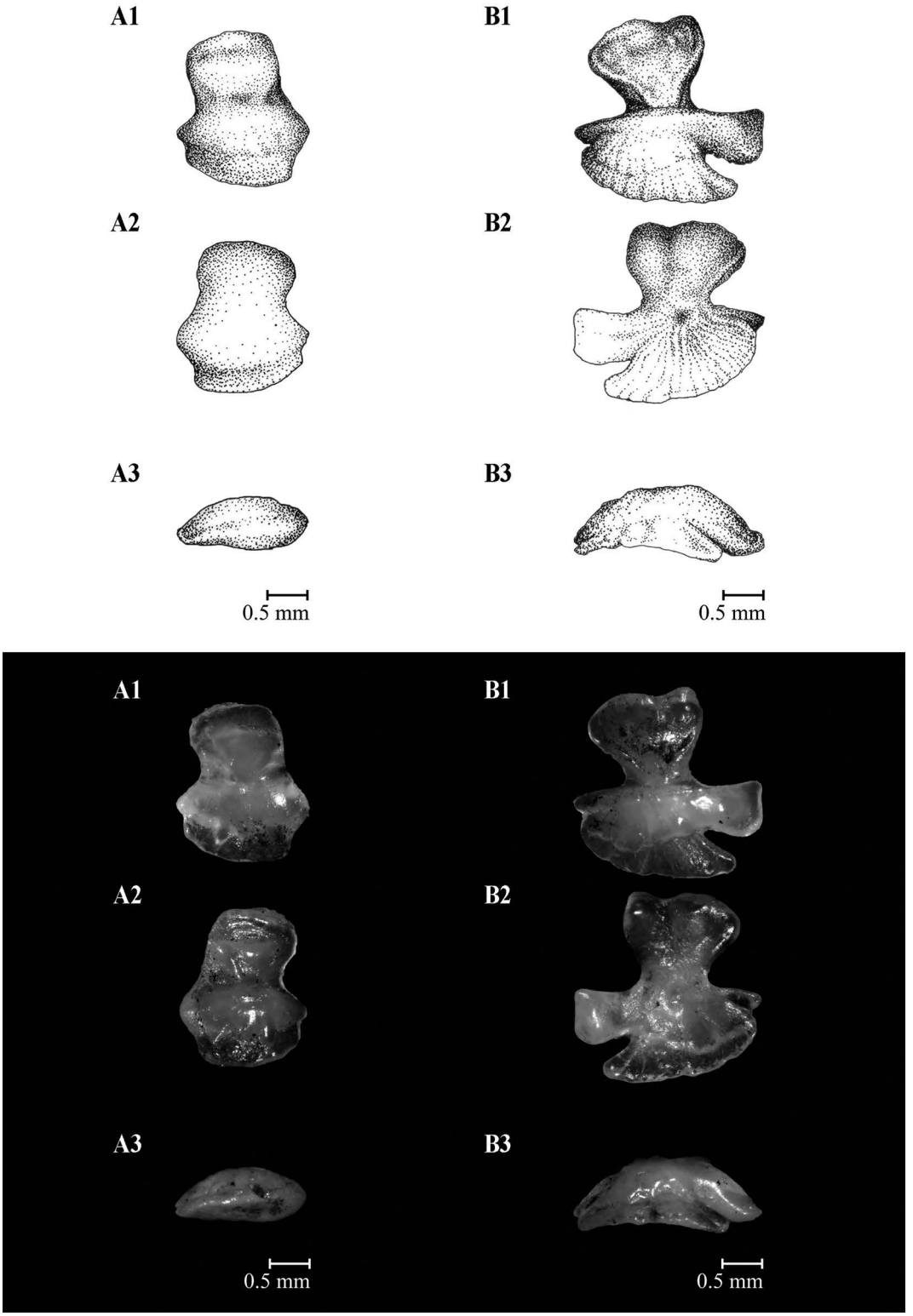


Plate 27. Illustrations (above) and photographs (below) of *Stephanolepis hispidus* otoliths from fish with total lengths: A. 37 mm; B. 195 mm. The medial face is shown in A1, B1; the lateral face in A2, B2; and the ventral profile in A3, B3 (Illustration: Alexandre Arackawa; Photos: Cesar Santificetur).